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Tax Reform and Revenue Growth to 1980

Staff Paper

Department of Treasury and Economics
Taxation and Fiscal Policy Branch

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Tax Reform and Revenue Growth to 1980

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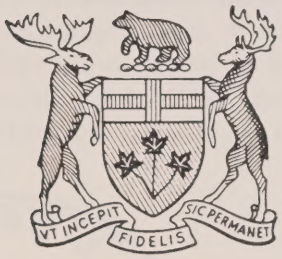

ONTARIO

Department of Treasury & Economics
Taxation & Fiscal Policy Branch

ONTARIO PROPOSALS FOR TAX REFORM IN CANADA

I	Hon. Charles MacNaughton	Ontario Proposals for Tax Reform in Canada
II	Hon. Charles MacNaughton	Tax Reform and Small Business
III	Hon. W. Darcy McKeough	Taxation of Corporations and Shareholders

ONTARIO STUDIES IN TAX REFORM (Staff Papers)

1. Analysis of the Federal Tax Reform Proposals
2. Effects of Ontario's Personal Income Tax Proposals
3. Technical Study on Tax Reform and Small Business
4. Tax Reform and Revenue Growth to 1980
5. Technical Study on Integration

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PREFACE

Two earlier Staff Papers, *Analysis of the Federal Tax Reform Proposals,* and *Effects of Ontario's Personal Income Tax Proposals,* contained analyses of the revenue and incidence effects of the federal and Ontario governments' proposals for the test year of 1969. It is important, however, that tax reform be viewed as a continuing process and studied under conditions of economic growth. This study, therefore, contains a comparative analysis of the revenue growth capacity of the existing, federal white paper and Ontario's proposed income tax systems under specified conditions of economic growth to 1975 and 1980.

The analysis of the revenue growth and incidence effects of the three tax systems to 1980 involved considerable development and refinement of the Ontario tax analyzer system which was used for the two earlier staff studies. The projection of potential output is derived from a computer model developed in conjunction with this study.

The study was undertaken by the staff of the Taxation and Fiscal Policy Branch, Ontario Department of Treasury and Economics. It is part of a continuing programme of quantitative analysis designed to provide a comprehensive insight into the revenue, incidence and economic effects of tax reform proposals in Canada. As other areas of study are developed the results will be published as quickly as possible to assist in broadening public involvement in this vital and complex field of government policy. We would welcome the co-operation and assistance of others in improving our estimates and analytic systems.

H. I. Macdonald
Deputy Treasurer and
Deputy Minister of Economics

T. M. Russell
Director
Taxation and Fiscal Policy Branch

March, 1971

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CHAPTER 1

INTRODUCTION AND SUMMARY

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INTRODUCTION AND SUMMARY

Detailed estimates of the revenue and incidence effects of tax reform proposals are of critical importance in designing and implementing tax structure changes. Without such estimates the effects of various tax proposals cannot be properly gauged in terms of achieving the twin objectives of increased equity and the promotion of economic growth. Two earlier Ontario Staff Papers contained quantitative analyses of the revenue and incidence effects of the tax reform proposals advanced by the federal and Ontario governments for the test year of 1969.[1] These studies provide useful comparisons of the initial impact of the two sets of tax reform proposals.[2] Equally important, however, are two further questions: how these alternative tax reform systems could be expected to perform in future years as the Canadian economy grows, and, how their performance would compare with the revenue growth generated by the existing income tax system. This study deals with this dynamic dimension of tax reform. It examines the revenue yield and revenue growth capacity to 1975 and 1980 of the existing income tax system, Ontario's proposed income tax system and the federal white paper system as outlined in November, 1969.[3] Its purpose is both to give insight into the potential long-run impact of these alternative tax reform proposals and to provide a standard of comparison against which they may be judged.

1.1 Importance of Long-Run Revenue Growth Analysis

This study is designed to provide a general indication of the future resources available to governments within the framework of full-employment economic growth.[4] In the development of policy alternatives in the public sector analyses of the revenue growth capacity of alternative income tax systems are valuable in four key areas of forward planning.

1. *Public sector planning.* The revenue estimates presented in this study provide a measure for control of the growth of Canada's public sector. They show the future revenue

---

[1] See, Hon. E.J. Benson, *Proposals for Tax Reform* (Ottawa: Queen's Printer, 1969), hereinafter referred to as the federal white paper, and Hon. C.S. MacNaughton, *Ontario Proposals for Tax Reform in Canada* (Toronto: Department of Treasury and Economics, 1970), hereinafter referred to as the *Ontario Proposals.*

[2] *Analysis of the Federal Tax Reform Proposals,* Ontario Studies in Tax Reform 1 (Toronto: Department of Treasury and Economics, 1970), and *Effects of Ontario's Personal Income Tax Proposals,* Ontario Studies in Tax Reform 2 (Toronto: Department of Treasury and Economics, 1970). Like the present study, these two studies analyse the revenue impact of the federal white paper proposals and the Ontario proposals with the assumption that each set of proposals had been implemented a sufficient number of years to be fully effective by the test year.

[3] This study does not incorporate the modifications to the original white paper proposals that have been announced since November 1969, nor does it analyse the tax reform proposals recommended by the Commons Committee or the Senate Committee. Like the earlier analyses for 1969, this study does not take into account possible behavioural responses by taxpayers to new tax regimes.

[4] Revenue estimates were a key requirement for example, in determining that the federal white paper proposals would reduce the rate of economic growth. See, A. R. Dobell and T. A. Wilson, "The Effects of the White Paper on Saving, Investment and Economic Growth", *Proceedings of the 22nd Conference* (Toronto: Canadian Tax Foundation, 1970), page 239.

streams that would be generated by alternative income tax systems, and thereby provide a basis for anticipating and preventing undesirable revenue growth and inflationary expansion of the public sector in the decade ahead.[5] Also, they demonstrate the propensity of income taxation to produce a revenue drag on the economy which must be offset if full employment is to be achieved.[6] In short, they measure the scope available for future tax reductions rather than increased government spending.

2. *Tax reform planning.* Revenue projections indicate the scope for devoting initial and continuing revenue increases to finance tax relief for low-income groups while minimizing tax increases on middle and upper-income groups. They demonstrate that there should be a continuing program of tax reforms to offset the erosion in real benefits to taxpayers which otherwise tends to occur over time because of inflation.[7] Furthermore, forward projections of revenue yield allow sensible staging of tax reforms as revenue growth materializes.

3. *Social security planning.* Forecasting of the revenue and incidence impact of tax reforms is also vital to the related area of social security reforms. The incidence effects of tax reforms should be explicitly taken into account in designing social security reforms and vice versa, in order to ensure that the combined redistributive impact is both fair and deliberate.[8]

4. *Federal-provincial planning.* Long-run revenue forecasts measure the pool of financial resources available to the federal and provincial governments in future years. As such, they provide a basis for negotiating a reasonable and orderly division of these tax resources between the two levels of government. In this respect, the projections set out in this study serve to improve the forward projections undertaken by the Tax Structure Committee.[9]

---

[5] For a discussion of the inflationary impact of rapid public sector growth see, Hon. C. S. MacNaughton, "The Public Sector and Economic Policy", *Ontario Budget 1970,* Budget Paper A (Toronto: Department of Treasury and Economics, 1970). The associated question of limits to taxation is a matter of continued debate. See, C. E. Forget, *International Tax Comparisons,* Royal Commission on Taxation, Staff Study 14 (Ottawa: Queen's Printer, 1966) pages 27-31, and R. M. Bird, *The Growth of Government Spending in Canada* (Toronto: Canadian Tax Foundation, 1970), pages 103-107.

[6] See, *Report of the Royal Commission on Taxation* (Ottawa: Queen's Printer, 1966), Vol. 2, Chapter 3, pages 53-115, and Joseph A. Pechman, *Federal Tax Policy* (Washington: Brookings Institution, 1971), pages 15-16 and 21-22 for a discussion of fiscal drag and its relevance to full-employment budgeting and economic growth.

[7] For example, the real value of the $1,000 personal exemption established in 1949 has been reduced to about $600.

[8] An income tax credit system as proposed by Ontario would increase the flexibility and redistributive potential of income taxation by allowing for positive tax refunds on a selective basis, and a direct link-up with income maintenance programs. See, Hon. C. S. MacNaughton, "The Reform of Taxation and Government Structure in Ontario", *Ontario Budget 1969* (Toronto: Department of Treasury and Economics, 1969), pages 55-57, and *Effects of Ontario's Personal Income Tax Proposals, op. cit.,* Chapter 4. Also, Hon. John Munro, *Income Security for Canadians* (Ottawa: Queen's Printer, 1970).

[9] For a discussion of the relationship between federal-provincial finance and the control of overall tax burdens, see Staff Paper, *Intergovernmental Policy Co-ordination and Finance* (Toronto: Department of Treasury and Economics, 1970).

1.2 Summary of Results

The major conclusion of this analysis is that the revenue growth capacity of the present income tax system, Ontario's proposed system and the federal white paper sytem is enormous. Even under a conservative projection of the economy to 1980, the revenue yield of the present income system would almost triple to $29.3 billion. Ontario's proposed reforms would tend to expand this long-run revenue-producing potential somewhat, to $30.8 billion. The federal white paper system would further expand this revenue capacity to $33.8 billion by 1980. This look ahead suggests, therefore, that there will be greatly expanded tax resources available to governments in the 1970's for advancement of national objectives – for distributing back to taxpayers through tax reductions, for financing comprehensive social security reforms, for implementing a more rational sharing of tax fields among governments or for other meritorious objectives.

Table 1-1

Projected Revenue
Under the Three Income Tax Systems
1969, 1975 and 1980

($ billion)

Income Tax System	1969	1975	1980
Present System	10.1	17.9	29.3
Ontario's Proposed System	10.1	18.4	30.8
Federal White Paper System	11.6	20.7	33.8

Source: Table 1-2

Notes: All taxes include both federal and provincial taxes, including the Old Age Security Tax, Social Development Tax and the temporary 3 per cent surtax.
For further notes, see Table 1-2.

The major findings of this study are set out in Tables 1 to 4 and are summarized below.

Income tax revenues under the present tax system would almost triple from $10.1 billion in 1969 to $29.3 billion in 1980. Even if the income tax reform legislation that is eventually adopted yields no more revenue than the present system, there would be substantial scope by 1975 to finance additional tax reforms such as: tax credits to compensate for sales and property taxes, reduction in income tax rates and new tax incentives to promote economic growth.

Without such future tax reductions, income tax revenues will steadily increase in relation to Gross National Product. Even under the present income tax system income tax revenues would grow from 12.7 per cent of G.N.P. in 1969 to 15.8 per cent by 1980. Under Ontario's proposed reforms the ratio of income tax revenues to G.N.P. would rise from 12.6 per cent in 1969 to 16.2 per cent in 1980. Under the federal white paper system there would be both an initial increase in income tax revenues to 14.5 per cent of G.N.P. in 1969, and a continuing rise to 18.2 per cent of G.N.P. by 1980.

Table 1-2

Projected Income Tax Revenue for Canada
Present System, Ontario Proposals, Federal White Paper Proposals

($ million)

	1969	1975	1980
PRESENT TAX SYSTEM			
Corporation income tax	2,633	3,884	5,406
Withholding taxes on non-residents	210	310	431
Other taxes on institutions and non-resident investors	–	–	–
Personal income tax	7,304	13,672	23,479
Total	10,147	17,866	29,316
ONTARIO PROPOSALS			
Corporation income tax	2,633	3,884	5,406
Withholding taxes on non-residents	210	310	431
Other taxes on institutions and non-resident investors	–	–	–
Taxation of Capital Gains	100	148	205
Small Business Incentive (1)	150	235	335
Personal income tax	7,012	13,881	24,424
Total	10,105	18,458	30,801
Increase in Revenue Over the Present System	–42	+592	+1,485
FEDERAL WHITE PAPER PROPOSALS			
Corporation income tax	3,571	5,264	7,325
Withholding taxes on non-residents	207	305	425
Other taxes on institutions and non-resident investors	115	170	236
Personal income tax	7,708	14,940	25,819
Total	11,601	20,679	33,805
Increase in Revenue Over the Present System	+1,454	+2,813	+4,489

Source: Figures for 1969 are from *Analysis of the Federal Tax Reform Proposals,* Ontario Studies in Tax Reform 1, (Toronto: Department of Treasury and Economics, 1970) Table 1-1, page 14 and, *Effects of Ontario's Personal Income Tax Proposals,* Ontario Studies in Tax Reform 2, (Toronto: Department of Treasury and Economics, 1970), Table 1 and, computer analysis of tax return sample. Figures for 1975 and 1980 are from Tables 2-1 and 2-2.

Note: (1) Net effect of substitution of small business incentive for dual corporate rate.

Income tax revenues, of course, comprise only a part of total government revenues. The remaining non-income tax revenue sources, however, can be expected to grow roughly at the same rate as G.N.P.. This means therefore, that the total public sector will claim a growing share of G.N.P..

Table 1-3

Projected Income Tax Revenues as a Percentage of Gross National Product 1969, 1975 and 1980

Income Tax System	1969	1975	1980
	%	%	%
Present System	12.7	14.0	15.8
Ontario's Proposed System	12.6	14.4	16.2
Federal White Paper System	14.5	16.2	18.2

Source: Tables 1-2 and 1-5.

Both Ontario's tax reform proposals and the federal white paper proposals would tend to generate revenues over and above the revenue growth of the present income tax system. These growth gains would be in the order of $1.5 billion by 1980 under the Ontario proposals and $4.5 billion under the federal white paper proposals. In recognition of the need to contain the growth of Canada's public sector, Ontario has consistently argued that tax reform should not accelerate the revenue-producing capacity of the income tax system.[10] Rather, as any revenue growth gains from tax reform materialize, they should be returned to taxpayers.

The increases in revenue yield under all three income tax systems are likely to grow more rapidly than the corresponding growth in government expenditure commitments as projected by the Economic Council of Canada.[11] If government spending stays within these bounds, therefore, there would be large fiscal dividends to allocate to continued tax reform and other priorities.

[10] See, *Ontario Proposals, op. cit.*, pages 7-8.

[11] Economic Council of Canada, *Sixth Annual Review: Perspective 1975* (Ottawa: Queen's Printer, 1969), page 32.

Table 1-4

Ratio of Projected Income Tax Revenues to Projected Government Expenditure 1969, 1975 and 1980

Income Tax System	1969	1975	1980
	%	%	%
Present System	60	61	63
Ontario's Proposed System	60	63	66
Federal White Paper System	69	70	72

Source: Appendix D.

1.3 Method of Projection

The revenue projections set out in this study are based on a projection of the Canadian economy to 1975 and 1980, assuming full-employment performance and a moderate 2.5 per cent rate of inflation. Appendix A sets out in full detail the assumptions and methods employed in deriving this economic growth projection. The underlying projection of economic growth should not be regarded as a forecast of the probable rate and pattern of development of the Canadian economy during the 1970's. Rather, it portrays an ideal or optimal economic framework within which the three tax systems would operate. The actual pattern of economic growth to 1980 is likely to be quite different, generating both lower real growth and higher inflation than assumed in this study.

Table 5, below, sets out the projection of potential economic growth to 1980 in terms of Gross National Product in current dollars. Potential Gross National Product could reach $128 billion by 1975 and $186 billion by 1980.

Table 1-5

Projection of Potential Gross National Product in Current Dollars

($ million)

Year	Projected	Actual
1967	65,721	65,722
1969	79,937	78,537
1975	127,852	
1980	185,910	

Source: Appendix A.

Notes: Unemployment is assumed to be about 3.0 per cent of the labour force. Prices are assumed to rise at about 2.5 per cent per year. Government spending rises at 9.6 per cent per year in current dollars or 7.1 per cent per year in real terms.

1.4 Effects of Different Economic Assumptions

Different economic assumptions, hence a different projection of Gross National Product to 1975 and 1980, would not materially affect the findings of this study. Under almost any given projection of economic growth the federal white paper tax system would generate large revenue gains over the existing system, and Ontario's proposed system would generate smaller revenue gains than the federal white paper proposals. Even a modestly higher rate of inflation than the 2.5 per cent assumed in this study would substantially increase the revenue growth capacity of all three tax systems. Below-potential growth in real output would tend to reduce the revenue yield under all three tax systems. On balance, any such extra inflation should more than offset reduced real growth, hence the revenue projections for all three tax systems are likely to be on the conservative side.

CHAPTER 2

DERIVATION OF THE REVENUE ESTIMATES

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2.2 Potential G.N.P. in 1975 and 1980 26

2.3 The Extrapolation Model 27

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2-2 Relationship Between Corporation Tax Attributable to Shareholders and Total Corporation Tax 24

2-3 Relationship Between Employed Labour Force and Employed Taxfilers Over 25 Years Old 29

DERIVATION OF THE REVENUE ESTIMATES

This chapter outlines in more detail the derivation of the revenue effects of the three tax systems for 1975 and 1980. The basic analysis and sample of tax returns is the same as that applied for the 1969 estimates in the first of the Ontario Studies in Tax Reform.[1] The sample comprises about 196,000 Ontario tax returns for the 1967 tax year.

The critical difference between the 1969 estimates and the results published in this study for 1975 and 1980 is the extrapolation procedure employed. The extrapolation problem involves two distinct phases. The first is the extrapolation of sources of income to the levels estimated for 1975 and 1980. The second is the extrapolation of the number of taxfilers in various groups distinguished by age, occupation and sex. The second phase estimates the number of individuals in 1975 and 1980 represented by each tax return in the 1967 sample.

The average taxfiler may receive income from a number of possible sources: employment income, professional and commission income and investment income of various sorts. Each source of income on a tax record is assumed to increase at the same rate as its aggregate counterpart in the G.N.P. between 1967 and the target years. The growth rate for each source of income is derived from, first, an estimate of potential current dollar G.N.P. in the target years, and second, an estimate of relative shares of the various sources of income in the total. The relative shares of the various sources of income in aggregate G.N.P. have been changing throughout the interval from 1947 to 1968. It is this interval from which the projections are derived. The relative shares for 1975 and 1980 take account of these secular trends.

The pattern of tax return filing in Canada has undergone continued shifts in the past. In particular, individuals under 25 and individuals over 65 have shown a marked increase in their propensity to file returns in recent years. Thus, in the extrapolation for taxfilers, the number of tax returns of individuals with differing age, occupation and sex characteristics are increased at varying rates, forming a changing distribution of filers in the target years. The aggregate number of taxfilers is estimated from the observed relationship between the total taxfiling population and the employed labour force. The employed labour force is estimated from projections of the civilian labour force in Staff Study 19 of the Economic Council of Canada.[2]

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[1] *Analysis of the Federal Tax Reform Proposals, op. cit.,* Chapter 4.

[2] Wolfgang M. Illing, *Population, Family, Household and Labour Force Growth to 1980,* Economic Council of Canada, Staff Study 19 (Ottawa: Queen's Printer, 1967), Table 4-2, pages 94-95.

The calculation of the tax implications of the present, and each of the proposed systems, is based on the sample as adjusted by the extrapolation procedure. The output of the computer analysis of tax returns is supplemented by estimates from other sources. The nature of these adjustments is outlined in the following section.

2.1 Personal Income Tax and Total Tax Revenue

Personal income tax under the three systems is shown in Table 2-1. Revenue from the present tax system, and all but three of the Ontario personal income tax proposals is derived from the computer analysis of tax returns. Derivation of the three Ontario proposals not included in the computer analysis is discussed below. The estimated revenue yield of the proposed federal tax system is derived from the computer analysis of tax returns supplemented by estimates from other sources. These additions for 1969 are outlined in Staff Paper One, Tables 8-1 and 8-2.[3] For 1975 the net effect of these additions is assumed to grow at the same rate as personal taxes under the proposed federal system.

The relationship between corporation taxes attributable to shareholders and total corporation tax is shown in Table 2-2. Estimated total corporate taxes for 1969 are from Staff Paper One, Table 1-1.[4] Corporate taxes attributable to shareholders are estimated from the computer analysis of tax returns. For all three systems studied in this paper, total corporate taxes are calculated on the assumption that in 1975 and 1980 they bear the same proportionate relationship to shareholder tax liabilities as in 1969. Additional revenue from provincial corporate tax rates above 10 per cent is assumed to grow at the same rate as total corporate taxes under the federal proposals.

---

[3] *Analysis of the Federal Tax Reform Proposals, op. cit.*, pages 109-111.

[4] *Ibid.*, page 14.

Table 2-1
Revenue from Personal Income Tax
($ million)

	1969	1975	1980
Present Tax System:			
Output of Computer Analysis	7,304	13,672	23,479
Estimated from Other Sources	—	—	—
TOTAL	7,304	13,672	23,479
Ontario Personal Income Tax Proposals:			
Output of Computer Analysis	7,002	13,861	24,386
Estimated from Other Sources	10	20	38
TOTAL	7,012	13,881	24,424
Federal White Paper Proposals:			
Output of Computer Analysis	7,711	14,946	25,829
Estimated from Other Sources	−12	−23	−40
Provincial Surtax on Added Personal Income	9	17	30
TOTAL	7,708	14,940	25,819

Source: For 1969, personal income tax as estimated by computer analysis and from other sources is found in Tables 1-1 and 8-1 in, *Analysis of the Federal Tax Reform Proposals,* Ontario Studies in Tax Reform 1, *op. cit.*

Notes: The proposed rate schedule in the federal white paper ignores the existing provincial surtaxes imposed by the provinces of Manitoba and Saskatchewan. The size of the extra revenue from the imposition of the Manitoba and Saskatchewan surtaxes on the tax increases from those provinces resulting from the white paper proposals for 1969 is estimated in, *Analysis of the Federal Tax Reform Proposals, ibid.,* Table 8-2, page 111. For 1975 and 1980 the estimates from other sources and the provincial surtax on added personal income tax revenue are assumed to grow at the same rate as personal taxes.

Table 2-2

Relationship Between Corporation Tax Attributable to Shareholders and Total Corporation Tax

($ million)

	1969	1975	1980
Total Corporation Taxes			
Taxes under present system	2,633.0	3,884.1	5,406.0
Taxes under the federal proposals	3,555.5	5,241.3	7,293.7
Tax change resulting from federal proposals	+922.5	+1,357.2	+1,887.7
Additional revenue from provincial corporate tax rates in excess of 10 per cent.	15.3	22.6	31.4
Total Estimated Revenue Increase Under the Proposals	+937.8	+1,379.8	+1,919.1
Corporation Taxes Attributable To Shareholders			
Present system, total	1,205.7	1,778.6	2,475.5
Total under federal proposals	1,704.0	2,511.9	3,495.5
Total change	+498.3	+733.3	+1,020.0

Sources: Total corporation taxes for 1969 are from, *Analysis of the Federal Tax Reform Proposals,* Ontario Studies in Tax Reform 1 (Toronto: Department of Treasury and Economics, 1970), Table 1-1, page 14. Corporation taxes attributable to shareholders are from *ibid.,* Table Table 6-10, page 83. Taxes on Section 105 Distributions are included in the total of corporation taxes allocable to resident individuals under the present system. Revenue resulting from provincial corporate taxes in excess of 10 per cent is from *ibid.,* Table 3-4, page 37.

Notes: Total corporate taxes under the present system in 1975 and 1980 are calculated assuming total corporate taxes in these years bear the same relationship to corporate taxes attributable to shareholders as was the case in 1969. Thus the relationship under the present system is 2.18. The relationship under the proposed federal system is 2.09. Additional revenue from provincial corporate taxes in excess of 10 per cent from additions to the corporate tax base is assumed to grow at the same rate as total corporate taxes under the federal proposals. Thus 1975 additional provincial revenue is 1.47 times the 1969 sum and 1980 is 2.05 times the 1969 sum. Corporation taxes under the Ontario proposals are assumed to be the same as those under the present system with the exception of the substitution of the small business incentive for the dual rate structure.

A detailed analysis of the revenue effects of the Ontario proposals by each reform is shown in Table 3-2. Apart from the substitution of a small business incentive for the present dual corporate income tax rate, the Ontario proposals primarily affect personal income taxes. The personal income tax effects of the Ontario proposals are estimated from the computer analysis of the large sample of tax returns. Thus, with the exception of the net additions to revenues after the application of the small business incentive, revenue from the corporation income tax and withholding tax under the Ontario proposals is assumed to be the same as under the present tax system. Table 3-3 shows the revenue effects of Ontario's proposals for other tax fields. To estimate the growth in revenues from these proposals the very simplest assumptions have been made. Revenue from Ontario's capital gains tax is assumed to grow at the same rate as revenue from the present corporation income tax. The revenue of $100 million from a capital gains tax assumed that there would be about $500 million in realized gains or gains taxed upon death or emigration in 1969. About $100 million is taken to be effectively exempt, partly through the exemption of the first $100 of capital gains intended to provide a lower effective rate to small investors.[5] A level of realized capital gains of $500 million in 1969 is about 0.3 per cent of the current value of gross private non-farm capital stock for Canada in that year. It is assumed that 20 per cent of realized gains continue to be effectively exempt in the future. In addition, the analysis implies that 0.3 per cent of the current value of gross private non-farm capital continues to be realized in 1975 and 1980. The estimate of the current value of the private non-farm capital stock is derived from the production function projection of G.N.P. outlined in Appendix A.

The Ontario proposals foresee the gradual introduction of the small business incentive.[6] The net increase in revenue in 1969 from substitution of the incentives for the dual rate structure is taken to be the amount generated after full implementation of the reform. This figure does not include the recovery of tax credits from disinvestment by owner-operators since these would have been negligible at that time.[7] The net revenues from the small business incentive are assumed to grow more rapidly than corporate tax revenue to 1975 and 1980 to reflect the gradual shift to the ordinary level of recovery of the tax credit on disinvestment.

The revised rental loss offset represents the expected increase in revenue from retaining the current rental loss offset arrangements but restricting them to residential properties.[8] In

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[5] *Ontario Proposals, op. cit.*, page 29, 45.

[6] *Ontario Proposals, op. cit.*, page 32, 45; Hon. C. S. MacNaughton, *Tax Reform and Small Business*, Ontario Proposals for Tax Reform in Canada II (Toronto: Department of Treasury and Economics, 1970), and, *Technical Study on Tax Reform and Small Business*, Ontario Studies in Tax Reform 3 (Toronto: Department of Treasury and Economics, 1970).

[7] It is estimated that the existing allowance for small businesses in the form of the dual rate on corporate income is worth $427 million in reduced taxes to all corporations in 1969. By restricting the incentive to small businesses only, this would be reduced to $277 million in 1969, $449 Million in 1975 and $729 million in 1980. Total corporation taxes would then increase by $150 million in 1969, $235 million in 1975 and $335 million in 1980 over the current tax system. The estimate for 1969 of the effect of elimination of the lower rate of tax on the first $35,000 of taxable income is found in *Analysis of the Federal Tax Reform Proposals, op. cit.*, Table 3-3, page 36.

[8] *Ontario Proposals, op. cit.*, page 39.

1969 the increase in revenue from the federal white paper's disallowance of losses in rental property is estimated at $22 million. The more restricted application of the present arrangements as presented in the *Ontario Proposals* is expected to yield $10 million in 1969, $20 million in 1975 and $38 million in 1980. This produces more rapid growth in revenues than anticipated from the corresponding federal white paper proposals. An indication of the relative impact of the Ontario proposal is the increase in projected revenues from 0.3 per cent of current dollar rent in 1969 to about 0.5 per cent of current dollar rent in 1980, as estimated in the projection outlined in Appendix A.

2.2 Potential G.N.P. in 1975 and 1980

The estimates of potential G.N.P. employed in this study assume full-employment growth from 1967 to 1980 with moderate inflation at 2.5 per cent per year from 1969.[9] Full-employment growth is assumed to be consistent with about 3.0 per cent unemployment of the civilian labour force or 3.5 per cent unemployment in the private non-farm sector. To derive potential G.N.P. the economy is divided into four sectors: agriculture, government, private non-farm and residential property. The relative importance of these sectors has shifted substantially since 1947 and this shift is expected to continue, at a somewhat reduced rate, to 1980.

To estimate the relationship between factor input and output in the agricultural and private non-farm sectors over the interval from 1947 to 1968, the Cobb-Douglas production function was employed. The production function is used to project agricultural output to 1980, assuming a continuing decline in the relative importance of the agricultural sector. Capital stock figures to 1980 in the agricultural sector are calculated on a two-year moving average. The projection of labour input in 1980 is based upon the changing historical relationship between man-hours of labour employed in agriculture and man-hours of labour employed in the total potential labour force over the interval from 1947 to 1968. Agricultural output is then derived from these factor inputs assuming the technical relationship described by the production function persists to 1980. The model indicates that the agricultural labour force will continue to decline, though at a diminishing rate, to 1980, but the capital stock will grow slightly and the real value of agricultural output measured in constant (1961) dollars will continue to expand, rising from about $2.0 billion in 1969 to $2.5 billion in 1980. Appendix A provides a more complete account of the projections of agricultural output.

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[9] The level of inflation consistent with the level of full employment assumed in the study may, in reality, be much higher than the rate that is assumed. The inflation rate of 2.5 percent may be taken to represent a goal of macro-economic policy rather than a prediction of the rate of inflation consistent with sustained growth. From 1967, the base year of the projection, to 1969, inflation is assumed to be at the actual levels for 1968 and 1969, about 4.0 and 4.2 percent respectively. (Subsequent revision of the National Account indicates inflation to have been 3.6 and 4.7 percent in 1968 and 1969 respectively. Use of these rates changes current dollar G.N.P. in 1980 by less than 0.1 per cent. *National Income and Expenditure Accounts,* Third Quarter 1970, D.B.S. cat. no. 13-001, (Ottawa: Queen's Printer), Table 21, page 48.)

Output in the private non-farm sector is projected assuming the technical relationship between output and inputs over the 1947 to 1968 interval will persist to 1980. In estimating the production function for this sector the co-efficient of capital is held equal to the share of income from capital. In projecting private non-farm output to 1980 the civilian labour force figures used are those estimated on demographic principles derived from the study by Wolfgang Illing, for the Economic Council of Canada.[10] The capital stock is generated iteratively in the projections. For a particular year, it is calculated as the previous year's stock, plus new investment in the sector, less the proportion of the old stock assumed to be discarded. The investment rate in the private non-farm sector is assumed to be 14.0 per cent of the previous years G.N.P. less a discard rate of 2.5 per cent. These assumptions are conservative. Testing these assumptions for the period 1947 to 1968, it was found that the resulting capital stock is 92 per cent of the actual and the G.N.P. within 1 per cent of actual G.N.P. in 1968.

Table A-10 in Appendix A shows the sensitivity of the estimates to various investment, discard and inflation rates. The projection to 1980 is from 1967, the year from which the sample of tax returns is derived. The estimates are very close to the actual figures in 1968 and 1969 because the lower investment rate in the projection is offset by the higher level of assumed employment in these years than that level which actually occured. For 1968 and 1969, actual rates of inflation are used.

In projecting the government sector to 1980 it is assumed that government employment remains at the same proportion of the civilian labour force that it reached in 1968. It is also assumed that government expenditure grows in real terms at the rate projected by the Economic Council of Canada.[11]

Rent has been declining as a proportion of G.N.P. since 1947. In the projections to 1980, it is assumed to remain about the same proportion of previous year's G.N.P. as it had reached in 1968.

2.3 The Extrapolation Model

The impact upon the economy of any income tax system, in terms of revenue yield and incidence, depends upon the number and relative distribution of taxfilers by income, occupation, age and sex. Because of the close relationship between the number of returns and tax revenues, the need for a reliable projection of the total number of tax returns is immediately apparent. The effect of shifting cross-sectional patterns of taxfilers is more complex and obscure and must be taken into account to avoid biased revenue and incidence estimates.

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[10] Wolfgang M. Illing, *op. cit.*, page 94-95.

[11] Economic Council of Canada, *Sixth Annual Review, op. cit.*, page 32.

Parallel to the problem of shifting proportions of tax returns among different types of people, is the varying distribution over time of the income components of G.N.P.. While income accruing to persons, as a percentage of G.N.P., has fluctuated only slightly around the 70 per cent mark, the trends of the components of personal income have varied considerably from 1947 to 1969. The revenue yield of any comprehensive tax system is very sensitive to the size, composition and average level of different income streams. The present study determines major shifts between types of income in a manner similar to the one employed in the previous Ontario studies. The future proportions of the components of G.N.P. are estimated using the figure for projected national income, whose derivation is described earlier. The various income streams of each taxfiler are then augmented by the percentage change occuring in the corresponding components of national income. In this manner, the components within an individual's total accrued income portfolio are projected to grow independently of one another.

When these income projections are incorporated with the selective population indices, average income moves in different directions, and by varying amounts, according to each individual's status. These comprehensive projections of income and population movements avoid the tendency to underestimate the number of tax returns in the lower income groups and allow predictions consistent with demographic and income experience.

In 1967 there were 8.1 million taxfilers. It is estimated this will increase to 11.7 million in 1975 and 14.0 million by 1980. This corresponds to an employed labour force of 7.4 million in 1967, 9.3 million in 1975 and 10.4 million in 1980. The close correspondence between the employed labour force figures used in the G.N.P. projection and the estimated number of employed taxfilers is shown in Table 2-3. The classification of taxfilers used in the tax analysis does not distinguish taxfilers under 25 years of age by occupation. As a result, the relationship examined is that between employed taxfilers over 25 and the estimated labour force over 25.

Table 2-3
Relationship Between Employed Labour Force and Employed Taxfilers Over 25 Years Old
(thousand)

	Actual	Projection	
	1967	1975	1980
Employed Labour Force over 25 years	5,602	6,925	7,886
Employed Taxfilers over 25 years	5,613	7,201	8,088
Ratio of employed taxfilers to employed labour force	1.00	1.04	1.03

Sources: Data for 1967 are from the 1969 edition of *Taxation Statistics* and from *Seasonally Adjusted Labour Force Statistics,* January 1953 to December 1968, Dominion Bureau of Statistics (Ottawa: Queen's Printer, 1969).

The number of taxfilers for 1975 and 1980 is from the computer analysis of tax returns. The employed labour force projections are from estimates of the future labour force by Wolfgang Illing, Economic Council of Canada, Staff Study 19, *op. cit.*

Two tests were performed on the sensitivity of the revenue estimates for 1975 to alternative distributions of tax returns. The tests are outlined more fully in Appendix C. Both tests assume the minimum plausible increase in tax returns from individuals not in the labour force. The two tests differ in the treatment of the distribution of tax returns of individuals whose primary source of income is from employment. These tests indicate that the revenue estimates in this study are insensitive to wide variation in the number and distribution of tax returns. They confirm that revenues are determined primarily by the growth of G.N.P..

CHAPTER 3

REVENUE AND INCIDENCE EFFECTS TO 1980

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REVENUE AND INCIDENCE EFFECTS TO 1980

This chapter examines in detail the revenue and incidence implications to 1975 and 1980 of the three income tax systems. The analysis for 1975 and 1980 is based on the same set of Ontario and federal proposals as examined within the framework of the 1969 economy in the earlier studies. The first section discusses the revenue effects of specific reforms under the federal and Ontario proposals. The second section examines the incidence of the tax burden under the present and each of the proposed systems.

3.1 Aggregate Revenue Effects of the Individual Reforms of the Federal and Ontario Tax Proposals

The revenue effects of the various reforms under the federal white paper proposals are detailed in Table 3-1. The revenue effects of the Ontario proposals are shown in Table 3-2 and Table 3-3. Under the federal white paper proposals, changes in tax rates and exemptions would yield $179 million more than the present personal income tax system in 1969 and would produce $950 million more in 1980. Ontario's proposed rate schedule and unchanged personal exemptions would raise $120 million more in 1969 rising to $1,040 million more in 1980. However, when the effects of the Ontario refundable tax credits and the low-income allowance are taken into account, the net effect is to produce a loss of $143 million in 1969 and a gain of $735 million by 1980.

The Ontario proposals indicate that the net effect of the changed definition of medical expenses and the attribution to employees of employer medicare contributions made on their behalf is an increase in revenue of $121 million in 1969 rising to $307 million by 1980. The net effect of the corresponding federal white paper proposals is $147 million extra in 1969 rising to $360 million extra revenue by 1980.

Under the federal proposals, the net effect of the inclusion of unemployment insurance benefits in income and the deductibility from income of unemployment insurance contributions produces a net revenue increase of $34 million in 1969 and $192 million by 1980. Under the Ontario proposals the net effect of these two reforms is roughly comparable.

In addition to the personal income tax effects of the federal proposals shown in Table 3-1, there is an implicit increase in revenue from taxes paid by corporations which is allocable to resident individuals filing tax returns. In 1969 the effect of the integration of corporation and personal income taxes and of widening the corporation tax base raises an extra $498 million.[1] In 1975 this amounts to $733 million and 1,020 million by 1980.[2]

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[1] *Analysis of the Federal Tax Reform Proposals, op. cit.*, Table 6-10, page 83.

[2] Computer analysis of sample of tax returns.

Table 3-1

Changes in Revenue Yield Under the Federal White Paper Reforms of Personal Income Taxation

($ million)

	1969	1975	1980
CHANGES IN TAX RATES, EXEMPTIONS AND THE TREATMENT OF EMPLOYMENT INCOME			
Changes in tax rates and exemptions	179	541	950
New definition of deductible medical expenses	56	95	129
Attribution to employees of employer medicare contributions	91	153	231
Inclusion of scholarship and fellowship income in the tax base	9	12	16
Optional standard expense allowance (1)	−235	−107	−117
Attribution of top employee benefits	77	190	485
Child care allowance	−14	−21	−30
Deductibility from income of unemployment insurance contributions and taxation of benefits (2)	34	91	192
CHANGES IN THE TAXATION OF OTHER BUSINESS AND PROPERTY INCOME			
Disallowance of losses on rental property arising from capital cost allowances and other specified expenses	22	34	46
Taxation of capital gains and allowances of capital losses of unincorporated businesses	7	11	15
Taxation of non-business capital gains and allowance of non-business capital losses	32	63	110
Farm capital gains and other farm income added to the tax base	6	7	7

Table 3-1 (cont'd)

Changes in Revenue Yield Under the Federal White Paper Reforms of Personal Income Taxation

($ million)

CHANGES IN THE TAXATION OF CORPORATE SOURCE INCOME	1969	1975	1980
Effects of integrating personal and corporation income taxes in the manner proposed in the white paper	-105	-156	-187
Taxation of capital gains and allowance for capital losses on corporate stock and reduction of capital gains rate on shares of widely-held corporations	303	444	624
Disallowance of shareholder depletion deduction	9	12	17
Inclusion of unreported dividends	4	7	9
Allowing unrealized capital gains on private companies to remain untaxed at death	-64	-102	-147

Source: Computer analysis of tax return sample.

Notes: (1) This diminishing revenue cost of the standard expense allowance occurs because of the $150 limit on this federal reform, and the assumption that taxfilers would itemize employment expenses as soon as it is to their advantage. The effect of this increasing itemization would more than offset the reduction in the revenue cost of the standard expense allowance.

(2) The structure of unemployment insurance benefits and contributions examined to 1980 represents the system which existed to the end of 1969. It does not include subsequent increases in the contribution rate, or benefits.

Table 3-2

Changes in Revenue Yield Under Ontario's Reforms of Personal Income Taxation

($ million)

	1969	1975	1980
CHANGES IN TAX RATES, EXEMPTIONS AND THE TREATMENT OF EMPLOYMENT INCOME			
Changes in tax rates and exemptions	120	534	1,040
Refundable tax credits	-188	-211	-221
Low-income allowance	-75	-82	-84
Revised dividend tax credit	-18	-27	-36
New definition of deductible medical expenses	46	79	117
Attribution to employees of employer medicare contributions	75	126	190
Inclusion of scholarship and fellowship income in the tax base	9	12	16
Employment expense allowance	-290	-395	-556
Revised treatment of expense accounts	40	117	326
Working mother child care credit	-50	-65	-90
Deductibility from income of unemployment insurance contributions and taxation of benefits (1)	23	81	167

Source: Computer analysis of tax return sample.

Note: (1) The structure of unemployment insurance benefits and contributions examined to 1980 represents the system which existed to the end of 1969. It does not include subsequent increases in the contribution rate, or benefits.

The federal proposals for taxes on capital include the following: taxation of capital gains and allowance of capital losses of unincorporated businesses; taxation of non-business capital gains and allowance of non-business capital losses; farm capital gains and other farm income added to the tax base; and, taxation of capital gains and allowance for capital losses on corporate stock and reduction of capital gains on widely-held common stock to half integration. The net effect of these reforms is an increase in tax revenue of $348 million in 1969 rising to $756 million by 1980. Under the Ontario proposals, death taxation is to be phased out as the capital gains tax matures. It is expected that net revenue gain would rise from $100 million in 1969 to $205 million by 1980.

Table 3-3
Changes in Revenue Yield
Under Ontario's Other Proposed Reforms
($ million)

Changes in the Taxation of Corporate and Property Income	1969	1975	1980
Taxation of capital gains (1)	100	148	205
Small business incentive (2)	150	235	335
Revised rental loss offset	10	20	38

Source: Independent estimates. Derivation of these estimates is dicussed in the text.

Notes: (1) Net effect of capital gains taxation and reduced death taxes.

(2) Net effect of eliminating the dual corporate rate and introducing small business incentive.

3.2 Detailed Analysis of the Incidence Effects of the Three Tax Systems.

Together with the revenue yield, the incidence of the tax burden among income groups is a critical consideration in tax reform.

This study shows the changing distribution of taxfilers among income classes up to 1975 and 1980. Table 3-4 shows the distribution of taxfilers by income classes under the federal and Ontario proposals for 1969. It also shows the share of total personal income tax receipts that would be generated by each income class under the three systems. For instance, under the Ontario proposals the income group below $5,000 would provide 10.6 per cent of total personal income tax revenue, compared with 14.3 per cent under the present system and 13.1 per cent under the federal proposals.

Table 3-4

Shares of Total Personal Income Tax Receipts Remitted by Income Class

1969

Income Class	Per Cent of Taxfilers in Class		Per Cent of Total Tax Revenue		
	Federal Proposals	Ontario Proposals	Present System	Ontario Proposals	Federal Proposals
Less than $5,000	52.96	53.72	14.33	10.55	13.12
$ 5,000–$7,999	24.22	24.25	23.98	23.40	22.30
8,000– 9,999	9.78	8.50	15.06	15.35	14.58
10,000–14,999	7.65	7.13	16.05	16.57	16.26
15,000–24,999	3.55	3.48	12.48	13.67	13.12
25,000 and Over	1.84	2.08	18.10	20.31	20.62

Source: Computer analysis of tax return sample.
Note: Numbers may not add to 100 per cent due to rounding.

By 1975, the proportion of total revenue generated by the under $5,000 income group would drop to 6.8 per cent under the Ontario proposals, 8.3 per cent under the federal proposals and 9.3 per cent under the present system. This declining trend would continue to 1980. These incidence changes are shown in Table 3-5 and 3-6.

Table 3-5

Shares of Total Personal Income Tax Receipts Remitted by Income Class

1975

Income Class	Per Cent of Taxfilers in Class		Per Cent of Total Tax Revenue		
	Federal Proposals	Ontario Proposals	Present System	Ontario Proposals	Federal Proposals
Less than $5,000	48.62	49.50	9.21	6.80	8.30
$ 5,000–$7,999	18.68	19.33	14.34	14.20	13.49
8,000– 9,999	10.07	9.66	12.15	11.73	11.98
10,000–14,999	12.56	12.27	21.55	22.28	21.93
15,000–24,999	7.13	6.91	20.34	22.24	20.78
25,000 and Over	2.94	2.33	22.41	22.39	23.52

Source: Computer analysis of tax return sample.

Note: Numbers may not add to 100 per cent due to rounding.

Table 3-6

Shares of Total Personal Income Tax Receipts Remitted by Income Class

1980

Income Class	Per Cent of Taxfilers in Class		Per Cent of Total Tax Revenue		
	Federal Proposals	Ontario Proposals	Present System	Ontario Proposals	Federal Proposals
Less than $5,000	44.43	45.29	6.23	4.84	5.79
$ 5,000–$7,999	16.20	16.51	9.06	8.83	8.62
8,000– 9,999	7.69	7.64	6.68	6.79	6.64
10,000–14,999	13.09	12.61	16.72	17.36	17.09
15,000–24,999	13.13	13.02	29.50	30.66	29.81
25,000 and Over	5.46	4.90	31.81	31.43	32.05

Source: Computer analysis of tax return sample.

Note: Numbers may not add to 100 per cent due to rounding.

The distribution of tax reduction and tax increases under the federal white paper within each income class is shown in Table 3-7. For instance, this table shows that there will be a diminishing proportion of taxfilers under $5,000 whose taxes will decline over the period. In the income groups over $5,000 an increasing proportion of taxfilers can expect increased taxes over the period, and in the $15,000 to $25,000 middle-income group all taxpayers will pay higher taxes by 1980. These changing tax burden effects of the federal white paper are shown in greater detail in Tables 3-8 and 3-9.

Table 3-7

Percentage Change in Total Taxes Attributable to Taxfilers Under the Federal White Paper Proposals for 1969, 1975 and 1980

		Percentage with Reduction in Taxes			Percentage with Increases in Taxes			
	Percentage with less than 5% change	More Than 50% Down	15–50 Down	5–15 Down	5–15 Up	15–50 Up	More Than 50% Up	Total %
Less than – $4,999								
1969	44	9	20	7	11	4	3	100
1975	39	8	20	8	13	6	4	100
1980	38	6	21	7	12	10	5	100
$5,000 – $7,999								
1969	51	2	12	23	10	2	–	100
1975	34	1	5	13	43	3	–	100
1980	26	–	4	9	57	4	–	100
$8,000 – $9,999								
1969	34	–	–	1	54	11	–	100
1975	37	–	–	2	52	9	–	100
1980	24	–	–	2	57	17	–	100
$10,000 – $14,999								
1969	34	–	–	1	54	11	–	100
1975	10	–	–	–	77	13	–	100
1980	6	–	–	–	74	20	–	100
$15,000–$24,999								
1969	1	–	–	–	72	26	–	100
1975	1	–	–	–	81	18	–	100
1980	–	–	–	–	88	11	–	100
$25,000 and Over								
1969	7	–	–	–	40	41	11	100
1975	6	–	–	1	53	34	7	100
1980	6	–	–	1	68	22	4	100

Source: Computer analysis of tax return sample.

Note: Total taxes attributable to taxfilers include taxes allocated to shareholders under the federal white paper integration proposals as well as personal income taxes.

Table 3-8

Percentage of Taxfilers in each Income Class which Would Experience the Indicated Percentage Change in Total Taxes Attributed to Individuals Under the Federal White Paper Proposals

1975

Income Class	Number of Individuals	Percentage whose taxes would be changed by less than 5 per cent	Percentage with Reduction in Taxes				Percentage with Increase in Taxes			
			More Than 50% Down	25–50 Down	15–25 Down	5–15 Down	5–15 Up	15–25 Up	25–50 Up	More Than 50% Up
Less than $ 1,000	1,044,817	68.77	1.8	3.2	23.8	1.0	0.03	0.03	–	0.03
$ 1,000–$ 1,999	1,269,828	10.60	18.6	10.5	15.8	9.9	7.45	2.32	7.33	7.96
2,000– 2,999	1,180,911	30.00	7.6	6.7	6.3	16.7	11.38	6.83	5.62	7.48
3,000– 3,999	1,212,083	49.13	7.8	7.9	4.8	3.5	21.94	2.02	1.75	0.69
,000– 4,999	969,748	27.32	3.4	7.3	8.3	7.3	27.32	1.74	0.77	0.58
5,000– 5,999	880,634	49.75	0.9	3.6	5.0	12.9	24.87	1.81	0.92	0.29
6,000– 7,999	1,301,075	24.00	0.4	1.1	2.0	12.6	56.03	2.73	0.82	0.26
8,000– 9,999	1,175,336	36.95	0.2	0.1	0.3	1.6	51.50	8.63	0.65	0.15
10,000– 11,999	608,988	18.78	0.1	0.1	0.1	0.4	66.46	12.99	1.07	0.14
12,000– 14,999	857,672	2.93	0.1	0.1	–	0.1	83.90	11.42	1.38	0.10
15,000– 19,999	613,261	0.46	–	0.1	0.1	0.1	81.88	12.83	4.25	0.30
20,000– 24,999	219,919	0.68	–	–	–	0.1	78.16	11.63	9.00	0.40
25,000– 34,999	162,505	1.36	–	–	–	–	67.39	12.16	18.25	0.78
35,000– 49,999	85,683	3.46	–	–	0.1	–	57.51	11.04	22.99	4.90
50,000– 74,999	47,645	12.34	–	–	–	–	35.85	11.97	23.88	15.93
75,000– 99,999	18,635	28.07	–	–	–	0.1	16.19	9.00	26.39	20.19
100,000–149,999	13,882	21.11	–	–	–	5.8	11.17	9.44	33.70	18.74
150,000–199,999	5,556	9.38	–	–	–	10.6	7.54	10.35	39.38	22.80
200,000–299,999	4,233	6.76	–	0.2	1.5	8.2	8.08	7.65	45.57	21.97
300,000 and Over	3,040	4.90	–	0.5	2.3	3.7	5.43	8.45	55.60	19.18

Source: Computer analysis of tax return sample

Note: Some figures may not add to totals due to rounding. Total taxes attributed to individuals include taxes allocable to shareholders under the integration proposals of the federal white paper as well as personal income taxes.

Table 3-9

Percentage of Taxfilers in each Income Class which Would Experience the Indicated Percentage Change in Total Taxes Attributed to Individuals Under the Federal White Paper Proposals

1980

Income Class	Number of Individuals	Percentage whose taxes would be changed by less than 5 per cent	Percentage with Reduction in Taxes				Percentage with Increase in Taxes			
			More Than 50% Down	25–50 Down	15–25 Down	5–15 Down	5–15 Up	15–25 Up	25–50 Up	More Than 50% Up
Less than $ 1,000	1,215,492	69.08	1.82	2.72	23.31	1.20	0.10	0.03	–	0.03
$ 1,000–$ 1,999	1,310,338	14.62	14.41	17.94	19.07	7.72	3.28	0.74	9.04	7.03
2,000– 2,999	1,264,857	14.90	6.80	6.19	6.24	14.35	12.26	16.92	7.58	13.85
3,000– 3,999	1,254,641	46.39	5.65	7.02	5.45	3.72	19.29	5.88	5.01	1.08
4,000– 4,999	1,180,109	49.64	2.06	4.61	6.00	6.59	26.18	2.27	2.03	0.63
5,000– 5,999	854,938	34.82	0.82	2.31	4.06	11.51	42.82	2.03	1.06	0.51
6,000– 7,999	1,415,569	20.01	0.22	0.88	1.68	6.98	65.18	3.53	1.12	0.38
8,000– 9,999	1,077,134	23.94	0.22	0.09	0.36	1.58	57.00	15.84	0.81	0.15
10,000– 11,999	642,559	12.93	0.15	0.04	0.14	0.38	61.70	23.11	1.35	0.20
12,000– 14,999	1,190,969	2.52	0.17	0.02	0.01	0.08	79.93	15.83	1.35	0.08
15,000– 19,999	1,261,827	0.41	0.11	0.07	0.01	0.04	88.23	8.68	2.35	0.11
20,000– 24,999	578,412	0.05	0.07	0.04	0.07	0.07	87.48	6.97	4.55	0.31
25,000– 34,999	395,740	1.05	0.02	0.10	0.02	0.02	81.81	7.11	9.14	0.73
35,000– 49,999	196,577	2.21	–	0.10	0.02	–	71.61	8.60	14.75	2.75
50,000– 74,999	92,143	13.57	–	0.06	0.01	0.01	47.53	11.71	17.96	9.15
75,000– 99,999	34,040	35.30	–	–	0.06	0.08	19.41	10.02	21.88	13.25
100,000–149,999	25,709	27.81	–	–	0.10	6.92	12.75	10.42	31.45	10.56
150,000–199,999	10,270	13.53	–	–	0.02	16.22	9.56	8.62	37.04	15.01
200,000–299,999	7,204	8.71	–	0.11	3.88	12.45	9.47	9.90	41.11	14.36
300,000 and Over	5,330	6.07	0.15	0.79	4.48	7.25	8.75	12.44	47.79	12.29

Source: Computer analysis of tax return sample

Note: Some figures may not add to totals due to rounding. Total taxes attributed to individuals include taxes allocable to shareholders under the integration proposals of the federal white paper as well as personal income taxes.

APPENDIX A

POTENTIAL GROSS NATIONAL PRODUCT PROJECTIONS

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POTENTIAL GROSS NATIONAL PRODUCT PROJECTIONS

A.1 The Concept of Potential Output

The estimates of the implications of the current tax system, the federal white paper tax proposals and Ontario's personal income tax proposals for 1975 and 1980 are based on values of Gross National Product derived by the procedure discussed in this appendix. The estimates of real Gross National Product for the selected years assume that an effective policy of maintained full-employment growth had been pursued since 1967 and would continue to 1980. The base year for the projection is 1967, to be consistent with the year from which the sample of tax returns is derived. As a check on the sensitivity of the results, the effect that the actual performance of the Canadian economy between 1967 and 1970 would have had on projected estimates has also been estimated supposing full-employment growth to be maintained from 1970 onwards.

The estimates are a measure of the growth of the potential of the Canadian economy to produce goods and services. No attempt is made to forecast what actual G.N.P. will be. A forecast is based on anticipated demand and supply conditions. Rather than attempt to estimate demand conditions, it is assumed that they are such as are needed to maintain full-employment growth and an examination is then made of the implications of these conditions for the capacity of the economy to supply goods and services.

Demand adjusted to maintain full-employment growth implies that, from the beginning of the projected period onwards, capital and labour are utilized at an optimum level throughout the economy. The optimum utilization of resources is then the level consistent with sustained growth. A utilization of resources greater than the optimum may be sustained for a short time and lead to a rate of growth of output temporarily higher than that at the optimum. However, because of resulting defrayed maintenance of existing capital stock, the rate of growth would eventually drop below that possible with optimal utilization. Investment would be diverted to make up for the neglected maintenance of the capital stock during the high growth interval.[1]

In this study, optimal utilization of capital and labour is assumed to be consistent with 3.5 per cent unemployment in the private non-farm labour force or about 3.0 per cent in the civilian labour force. Judged by this assumption, the economy was close to full utilization of the potential labour force in 1947 through 1949 and 1951 through 1953 as well as in 1956 and 1965.[2]

[1] The concept of maintained full-employment growth is discussed in T. A. Wilson and N. H. Lithwick, *The Sources of Economic Growth,* Studies of the Royal Commission on Taxation, No. 24 (Ottawa: Queen's Printer, 1968), Chapter 1.

[2] The assumption of 3.5 per cent unemployment in the private non-farm sector and about 3.0 per cent in the civilian labour force compares with 4.0 per cent unemployment in the private non-farm sector and 3.5 per cent unemployment in the civilian labour force, selected as targets by the Royal Commission on Taxation. See, Wilson and Lithwick, *ibid.*, pages 26-27 and footnote 2.

A.2 The Technical Possibilities of the Canadian Economy

To estimate future capacity output, the Canadian economy has been divided into four sectors: agriculture, government, private non-farm and residential property. The relative importance of these sectors has changed substantially since the Second World War. The importance of agriculture has steadily diminished and that of government increased. The importance of rent as a proportion of domestic product has diminished. In the projection of the capacity of the Canadian economy to 1980 it is assumed that these sectors will continue to behave independently. The derivation of potential output to 1980 for each of these sectors is discussed below.

(a) The Private Non-farm Sector

In the private non-farm sector actual output in the period 1947 to 1968 was a consequence of the level of utilization of the available supplies of capital and labour and the technical possibilities of the production relationship. In this study it is assumed that optimal use of the factors of production is consistent with 3.5 per cent unemployment in the private non-farm labour force. Potential output of the 1947 to 1968 period is then the output the economy could have produced had the available resources been used at the optimum level. Potential output to 1980 is the output the economy has the capacity to produce if expected levels of the factor inputs are employed continuously at the optimum level of utilization.

The technical relationship between inputs and final output is described by the production function. This function indicates the optimal level of output that can be achieved provided efficient use is made of the available factor inputs. The potential output of the Canadian private non-farm sector from 1947 to 1968 is estimated employing an aggregate production function. The technical relationship indicated by this function is assumed to persist to 1980.

A production function for an entire economy or even a major sector of an economy provides a highly summary description of activities actually carried out by individual firms and enterprises. In making such a summary description of the production relationship within the economy, it has been necessary to face the question of the appropriate conditions under which the activities of individual enterprises may be aggregated. Not all of the conditions strictly required to make such a consistent aggregate estimate are likely to be satisfied. This would remain so even were the objective to summarize the technical possibilities within an individual firm.

However, the lower the level at which aggregation is undertaken, the more closely are the conditions for consistent aggregation likely to be satisfied. By the partial disaggregation of the economy which is adopted here, a slightly closer approximation to the required condition may be expected than under full aggregation.

In this study it is assumed that the production function exhibits constant returns to scale. This, along with the assumption that the relationship described by the production function means efficient use of factor inputs, implies that there is no difference between one big firm and two small ones if both are producing efficiently.

With constant returns to scale, consistent aggregation of capital requires that the firms or sectors of the economy differ from each other only by capital augmenting technical differences. Under this assumption, capital may be measured in efficiency units. With capital augmenting technical differences, an efficient distribution of labour will cause firms to differ only in scale. Then with constant returns and homogeneous labour, firms may be added together.[3] The possibility of aggregating capital implies the possibility of aggregating labour.[4] Because, in this study, capital is assumed to be homogeneous through time, and thus not adjusted for capital augmenting technical differences, the conditions for consistent aggregation are not strictly satisfied. However, the level of aggregation employed in this study should make the capital stock within each sector more homogeneous than the aggregate capital stock.

Technical factors are not the only ones which determine the output possible from a given supply of factor inputs. Institutional relationships may also constrain the output possible from available resources. In this study it is assumed that whatever institutional barriers would have operated to restrain output to less than its technical maximum, given optimum employment of resources between 1947 and 1968, will continue to do so to the same degree between 1967 and 1980.

The aggregate production function gives an exact representation of an economy only where very restrictive conditions are satisfied. Because these conditions cannot be completely met in practice, it has been necessary to decide whether the production function gives an adequate approximation in reality for the variables observed in the Canadian economy. The estimates of aggregate functions for the agricultural and private non-farm sectors of Canada are taken to be a satisfactory guide to the minimum capacity of the Canadian economy to produce goods and services with a policy of full employment maintained to 1980. The objective has not been to estimate the most likely capacity of the Canadian economy in 1980, with maintained full-employment growth, but to estimate the minimum capacity in the light of historic technical production relationships and anticipated growth of factor supplies. The decision to use the aggregate production potential of the Canadian economy has been governed by the overall objective of this study to estimate the revenue implications of the various tax systems for bench mark years in the future.

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[3] This discussion follows that given by F. M. Fisher, who also presents a formal proof. See, Franklin M. Fisher, "The Existence of Aggregate Production Functions", *Econometrica*, Vol. 37, No. 4 (October 1969), page 553.

[4] Fisher, *ibid.*, page 560, 565.

The greater is current dollar G.N.P. for any given year, the greater is the divergence between the implications of the present tax system and the federal white paper proposals. Therefore, an estimate is made of the minimum attainable level of current dollar G.N.P., consonant with a policy of maintained full-employment growth.

The production function for the private non-farm sector has been specified as Cobb-Douglas in form. This is a very restrictive specification. Not only does it imply constant elasticity of substitution between capital and labour for variations in the capital-labour ratio, but it also implies that this elasticity is equal to one. This specification further implies that technical change must enter multiplicatively. That is, technical change must be either "Hicks" or "Harrod" neutral but there is no way of distinguishing the two types from the estimates. In the Cobb-Douglas case, the assumption that factor and commodity markets are competitive in the long run implies that factors are paid according to their marginal productivities. This in turn means that in the Cobb-Douglas case, the exponents of labour and capital equal their respective shares of income:

$$Y = A(t)\, Lp^{1-\alpha} K^{\alpha}$$

Y is potential output of the private non-farm sector. It is the sum of actual output as observed and the additional output which would have been possible had all factors available each year been utilized throughout the period 1947 to 1968 at their full-employment level. The actual stock of resources available in any year is a result of the actual performance of previous years. In determining the stock of resources for calculations of potential output, "bygones are bygones". Thus, resources are not increased to reflect what they might have been had higher utilization been maintained in the past.[5] Lp is the effective potential labour force. This is the full-employment private non-farm labour force adjusted for changes in the average work week. K is the private non-farm capital stock as estimated by the Dominion Bureau of Statistics. The statistical series employed for each of these values is discussed more completely below.

The decision to specify the production function as Cobb-Douglas is a consequence both of the intrinsic simplicity of this function and some evidence indicating that more complex formulations are unlikely to yield more reliable estimates. In tests of a variety of possible ways of specifying technical change it has been shown that the estimated function turned out to be Cobb-Douglas, or the slightly more general C.E.S. function, in every case.[6] The C.E.S. or Constant Elasticity of Substitution production function does not constrain the elasticity of substitution to one as in the Cobb-Douglas case but requires only that it be

[5] See, Wilson and Lithwick, *op. cit.*, page 6 for a discussion of the distinction between potential and maintained full-employment output.

[6] Martin J. Beckman and Ryuzo Sato, "Aggregate Production Functions and Types of Technical Progress: A Statistical Analysis", *American Economic Review* (March 1969), page 95.

constant. The benefits of additional generality of the C.E.S. specification are to some extent offset by the diversity of results in previous attempts to estimate the elasticity of substitution. "Even slight variations in the period or concepts tend to produce drastically different estimates of the elasticity".[7]

In estimating the Cobb-Douglas function for the private non-farm sector from 1947 to 1968 in Canada an adjustment has been made for departures from the assumed level of full-employment utilization of factors of production. The adjustment has been made by the discrepancy between actual private non-farm employment and potential at the assumed full-employment rate. This is a first approximation. It is deficient because of the occurrence of concealed unemployment during recessionary periods; employers often will retain employees on short time rather than lay them off. Thus, actual utilization in recessionary periods is likely to be less than indicated by the utilization variable.

The Cobb-Douglas production function for the private non-farm sector has been estimated in the form:

$$Q = A(t)\, Lp^{1-\alpha} K^{\alpha} \frac{La^{\lambda}}{Lp}$$

where: Q is observed actual output.
Lp is the effective potential labour force.
La is the actual labour force employed in the sector from 1947 to 1968.
λ is the exponent of the cyclical variable $\frac{La}{Lp}$. It measures the elasticity of the output with respect to changes in the degree of labour utilization and is assumed to be constant.

Both sides of the production function were divided by Lp and technology was assumed to increase exponentially.

Thus, $q = e^{\beta t} k^{\alpha} u^{\lambda}$

where $q = \frac{Q}{Lp}$

$k = \frac{K}{Lp}$

$u = \frac{La}{Lp}$

[7] Marc Nerlove, "Recent Empirical Studies of the C.E.S. and Related Production Functions", *The Theory and Empirical Analysis of Production*, Studies of Income and Wealth, (New York: National Bureau of Economic Research, 1967), Vol. 31, page 58.

The exponent of capital, α, represents the share of capital in income and is assumed to be constant. The function derived from the private non-farm sector from 1947 to 1968 is:

$$\log q - .297 \log k = .6644 + .0183t - 1.5760 \log u$$
$$(26.38) \quad (4.79)$$

$$R^2 = .9766$$

$$DW = 1.64$$

where the figures in brackets are "t" statistics.

Output Private non-farm output is measured in constant (1961) dollars over the 1947 to 1968 period. The output series used in this study is derived following the method employed by R. G. Scott.[8] Private non-farm output is total gross domestic product less domestic product originating in agriculture, government and through residential rents.

Total gross domestic product is used to avoid problems of estimating real economic depreciation. The gross domestic product series is put on a National Accounts basis by using 1961 Gross Domestic Product as a base and an index estimated from real gross national expenditure net of interest and dividends paid to foreigners and residual errors of estimate.

Capital Stock The capital stock series for the private non-farm sector from 1947 to 1968 is mid-year gross capital stock for the manufacturing and non-manufacturing sectors excluding agricultural, residential, and government capital stocks. The data is in constant (1961) dollars, and has been made available by the National Wealth and Capital Stock Section of the Dominion Bureau of Statistics (D.B.S.). The capital stock figures are still of a tentative nature and revision of these series by the D.B.S. is continuing.

The D.B.S. derives the capital stock figures using the "perpetual inventory" method.[9] Mid-year gross stock at time (t) is calculated as the simple average of end-year gross stock at time (t) and time (t-1). This mid-year series is taken as a reasonable approximation of capital stock in the production process. A gross capital stock series rather than one net of depreciation is used because of the problems of estimating real economic depreciation.

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[8] R. G. Scott, Appendix A, in, Wilson and Lithwick, *op. cit.*, page 235.

[9] The detailed account of the methodology of the measurement of the stock of fixed reproducible capital is to be found in *Fixed Capital Flows and Stock, Manufacturing, Canada,* Dominion Bureau of Statistics, cat. no. 13-522 (Ottawa: Queen's Printer, February, 1967).

The D.B.S. has made five separate estimates of the capital stock series. Each estimate is distinguished by an assumed set of "lives" of the various items comprising the stock. Set 1 estimates have been used. The other four sets of "lives" range about this first set.[10]

Analysis of the disaggregated manufacturing groups indicated that the broad secular and cyclical movements are relatively unaffected by the different sets of hypothetical "lives".[11]

Income Shares The average share of income of capital in total output of the Canadian economy from 1947 to 1968 is assumed to be the co-efficient of capital in the production function analysis of the private non-farm sector. Income of capital is total investment income plus inventory valuation adjustment plus capital consumption allowances and miscellaneous valuation adjustments less investment income earned in agriculture plus one-third net income of non-farm unincorporated business including rents less gross tenant and resident rent.

Labour income equals total wages, salaries and supplementary labour income plus two-thirds of net income of non-farm unincorporated business. The procedure of R. G. Scott has been followed in allocating two-thirds of non-farm unincorporated business income to labour and one-third to capital.[12] This allocation is arbitrary.

In so far as possible, the latest revised National Accounts figures are used and are found in *National Income and Expenditure Accounts, 1926–1968* (Ottawa: Queen's Printer, 1969). Table A-1 displays the incomes of labour and capital which are used to derive the average share of capital.

Labour Force The annual amount of work performed in the economy is a result of the level of employment and the average amount of work each participant in the work force performs in the course of the week. The number of hours in the average work week in the manufacturing sector has shown a secular decline in the post war era. It is also sensitive to fluctuations in the level of activity of the economy.

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[10] *Ibid.*, pages 87-90. The average economic lives estimated in this set and the range of lives of the four derived sets are set out in Table 25 and Table 26, respectively.

[11] The trend and level of potential output as estimated by a Cobb-Douglas production function will not be altered by a proportionate change in factor inputs. The assumption is therefore that the rate of growth of the capital stock is similar for the five sets of economic life. This assumption is based upon the analysis of secular trends of capital stocks of various manufacturing groups for each set of "lives".

[12] R. G. Scott, Appendix A, in, Wilson and Lithwick, *op. cit.*, page 239.

Table A-1

Income of Labour and Capital

1948–1967

Year	Labour Income	Income of Capital	Per Cent Share of Capital Income
	($ million)		
1948	8,417	3,079	26.78
1949	9,088	3,622	28.50
1950	9,745	4,222	30.23
1951	11,312	4,642	29.10
1952	12,617	5,550	30.55
1953	13,764	5,698	29.28
1954	14,101	5,684	28.73
1955	15,178	6,624	30.38
1956	17,004	7,601	30.89
1957	18,402	7,873	29.96
1958	18,917	7,936	29.55
1959	20,188	8,649	29.99
1960	21,167	8,904	29.61
1961	22,002	9,291	29.69
1962	23,457	10,252	30.41
1963	25,105	11,036	30.54
1964	27,362	12,536	31.42
1965	30,463	13,419	30.58
1966	34,340	14,429	29.59
1967	37,892	14,928	28.26

Sources: Labour income equals total wages, salaries and supplementary labour income plus two thirds of net income of non-farm unincorporated business.

National Income and Expenditure Accounts, 1926–1968, (Ottawa: Queen's Printer, 1969), Summary Table A, lines 1 and 7.

Income of capital is total investment income plus inventory valuation adjustment plus capital consumption allowances and miscellaneous valuation adjustments less investment income earned in agriculture plus one third net income of non-farm unincorporated business including rents less gross tenant and resident rent.

Investment income earned in agriculture is from *National Accounts* (Ottawa: Queen's Printer) 1961 and 1967 annual editions; 1926–1956 summary edition, Table 23, line 1. Net income of non-farm unincorporated business including rents is from *National Income and Expenditure Accounts, 1926–1968* (Ottawa: Queen's Printer, 1969) Summary Table A, line 7. Total investment income plus inventory valuation adjustment plus capital consumption allowances and miscellaneous valuation adjustments is from *National Income and Expenditure Accounts, 1926–1968* (Ottawa: Queen's Printer, 1969), Summary Table A, lines 3, 5, 8, 11. Gross tenant and resident rent is in current dollars from *National Accounts* (Ottawa: Queen's Printer) 1961 and 1967 annual editions, Table 47, lines 12 and 14; 1926–1956 summary edition, Table 47, lines 12 and 14.

The potential private non-farm labour force is the civilian labour force excluding agricultural employment and unemployment, and government and defence employees. The effective labour force is the labour force in any given year adjusted for changes in the average work week. The average hourly week in manufacturing is taken as an adequate proxy for the entire private non-farm sector in estimating the effective labour force.

The total civilian labour force and the employed agricultural labour force figures are taken from estimates of the civilian labour force and its main components in the *Canada Year Book* (Ottawa: Queen's Printer), for 1969 and preceding years. Agricultural unemployment for 1953 through 1964 is from Sylvia Ostry, *Unemployment in Canada* (Ottawa: Queen's Printer, 1968), page 18. Agricultural unemployment from 1947 to 1952 and 1965 to 1968 is estimated as a function of employment in the entire economy.

Government employment is estimated from tax return data. Government employment is the sum of tax returns from employees in the federal, provincial and municipal governments. This data is found in *Taxation Statistics* (Ottawa: Queen's Printer) in the table titled *All Returns by Occupation,* in various editions from 1953 to 1970.

Because postal services are included with the output of the transportation, storage and communication industries, postal workers are subtracted from the total number of government employees. Post office employment includes both temporary and full time staff. The numbers of postal workers come from *Federal Government Employment,* D.B.S. catalogue number 72-004 and the earlier series, *Federal Civil Service Employment and Payrolls.* Government employment less postal workers is estimated for 1947 through 1950 by interpolation of a function of government employment over time.

The effective potential labour force is the number of individuals in the work force adjusted for variations through time in the amount of work actually performed in the course of a week. The average weekly hours in the manufacturing sector have been employed to estimate potential hours in the entire private non-farm sector from 1947 to 1968. This data is found in the table for Average Weekly Hours of Hourly Rated Wage Earners in, *Review of Man-Hours and Hourly Earnings,* D.B.S. catalogue number 72-202 (Ottawa: Queen's Printer).[13]

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[13] Sensitivity tests of the results have been conducted with alternative average weekly hour data. This data was made available on a confidential basis by the Productivity Research and Analysis Section of the D.B.S.. Two series were tested: the first, a weighted average of weekly hours for the entire economy and the second, a weighted average for the economy less non-commercial services. The average work week has declined rapidly in the manufacturing sector and most rapidly for the economy as a whole. The more rapidly the work week drops, the more slowly the effective work force increases, and the higher the implicit rate of technical change in estimates of the production function of the private non-farm sector. In projections to 1980 the stimulus to growth implicit in a higher rate of technical change is, however, offset by the corresponding slower growth of the effective labour force.

Following R. G. Scott, potential hours are estimated as a function of time and the employment rate.[14]

The estimate is:

$$\log AWH = 1.8476 - .00149t + .41430 \log \text{Emp. Rate}$$
$$(4.45) \quad (3.55)$$

$R^2 = .77$

SEE = .0086

DW = .69

The values in the parentheses are "t" statistics.

AWH is average weekly hours in manufacturing, "t" is time and Emp. Rate is the actual percentage of the potential private non-farm labour force employed.

To obtain the effective labour force, the potential private non-farm labour force is multiplied by the index of the potential hourly work week at maintained full employment. The potential hours index is derived by estimating average weekly hours assuming the employment rate to be 96.5% of the private non-farm sector labour force. The resulting index moves from 102.11 in 1947 to 98.96 in 1968. This represents a change from a full-employment week in 1947 of 42.1 hours as compared to the actual average hourly week of 42.5 hours at the time, to a full-employment week of 40.8 in 1968. In 1968 the actual average work week was 40.3 hours. If full-employment growth to 1980 is assumed to represent 96.5% employment in the private non-farm sector, the potential hours index falls to 97.21 or 40 hours per week. Had it seemed reasonable to regard full employment in the private non-farm sector as 96% of the labour force, the full-employment week would have been 40.7 hours in 1968, 0.1 below the average hourly week for the full-employment rate of 96.5% of the private non-farm labour force.

(b) The Agricultural Sector

A fully aggregated estimate of maintained full-employment growth of G.N.P. requires an estimate of the anticipated performance of the agricultural sector. This is difficult to obtain for a number of reasons. First, annual levels of agricultural output are subjected to marked fluctuations, due mainly to varying weather conditions. Estimates of the deviations of agricultural production from yield trends, carried out by L. Auer, reveal the erratic nature

[14] R. G. Scott, Appendix A, in, Wilson and Lithwick, *op. cit.*, page 244.

of farm production in Canada during the period 1947 to 1965.[15] Second, dramatic intersectoral shifts from agriculture to the rest of the economy have occurred since the Second World War.[16] As a result, the medium and long term trends in agricultural employment and output are not clear. The primary object has been the estimation of future agricultural production, assuming the post-war course of secular adjustment to persist to 1980. The procedure is to estimate the post-war historic production function and assume it applicable to the projection period. Future output is then the result of the technical relationships indicated by the production function and independent forecasts of broadly aggregated resource inputs.

The following describes the estimation of the agricultural production function, the data used, the projections of output to 1980, the extrapolation of capital and labour inputs to 1980, and a summary of the equations, parameters, and projections estimated in the model.

The statistical specification of an agricultural production function, over the period 1947 to 1968, is Cobb-Douglas. This specification assumes that the disturbance term in the production function enters as a multiplicative non-negative random variable u with a mean of unity, i.e., the Cobb-Douglas production function assumes the following relationship.

$$\text{Output}_t = A(t) L_t^{\alpha_2} K_t^{\alpha_3} u_t,$$

where L_t is Labour input at time t; K_t is Capital input at time t; A(t) is some measure of technical change over time. The specific form estimated is:

$$\text{Output}_t = \alpha_1 L_t^{\alpha_2} K_t^{\alpha_3} e^{\alpha_4 t} u_t$$

Taking logarithms,

$$\log \text{Output}_t = \log \alpha_1 + \alpha_2 \log L_t + \alpha_3 \log K_t + \alpha_4 t + \log u_t$$

The method of estimation is a least-squares regression of log Output on log L, log K, and t. The primary concern in this analysis is the estimation of output levels and not the specification of the co-efficients. It is generally concluded that for the purposes of extrapolation of output, given capital and labour inputs, the least-squares approach is the best.[17]

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[15] L. Auer, *Canadian Agricultural Productivity,* Economic Council of Canada, Staff Study No. 24 (Ottawa: Queen's Printer, 1969), page 60.

[16] A description of the nature and extent of these shifts can be found in N. H. Lithwick, *Economic Growth in Canada* (Toronto: University of Toronto Press, 1967).

[17] A simple discussion of the method of econometric estimation of the production relationship may be found in A. A. Walters, *An Introduction to Econometrics* (London: Macmillan, 1968). A more recent analysis of past studies of production functions has been made by M. J. Beckmann and Ryuzo Sato, *op. cit.*

In L. Auer's study of agricultural labour and capital productivity trends in Canada a Cobb-Douglas production function of the form and specification:

$$U = X_1^{.464} \cdot X_2^{.136} \cdot , \ . \ . \ . \ , \cdot X_{15}^{.045} \cdot 10^{1.961 + \ .008t}$$

is estimated. Here U is output per worker, $X^1, \ldots, X^{15}$ are resource inputs of labour and capital, and the exponential time trend is a measure of other changes causing productivity improvements. Capital inputs are disaggregated and the exponents of capital and labour inputs are estimated from factor shares. The time trend variable is estimated from the regression equation:

$$\log_{10}\left(\frac{Y}{\prod_{i=1}^{15} X_i^{\beta i}}\right) = \alpha_0 + \alpha_1 t + u$$

A necessary criterion in projecting a production function is that measures of projected inputs be possible. The method used in this study is therefore to group all inputs into the two factors, labour and capital, whose future aggregate levels could reasonably be estimated.

Estimates of fixed capital stocks in manufacturing and non-manufacturing industries have been developed by the Dominion Bureau of Statistics. As noted earlier, though the capital stock series are of a tentative nature, they are improvements upon previous estimates employed in studies on economic growth in Canada. Series of structures, equipment and capital items charged to current expenses, from 1926 to 1968, have been estimated. The data on agricultural capital stocks and flows has recently been collected and is a component of the D.B.S. measure of capital assets in non-manufacturing industries.[18] A more detailed discussion of the capital stock series is contained in the account of data used for the private, non-farm sector. Because of the difficulties in arriving at a satisfactory measure of depreciation, the measure of capital used in the production function is gross rather than net capital stock.

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[18] A complete description of methodology is found in *Fixed Capital Flows and Stocks, Manufacturing, Canada, 1926-1960,* Dominion Bureau of Statistics, cat. no. 13-522, (Ottawa: Queen's Printer, 1967). This document deals mainly with the estimation of a capital stock series for manufacturing and the difficulties therein. However, the "perpetual inventory" method, employed in estimations of both the manufacturing and non-manufacturing sectors, is fully described. The data for non-manufacturing industries has only recently been collected. Accounts of the sources and methodology for deriving capital stocks and flows in some of the non-manufacturing sectors, including Agriculture, are now available from the National Wealth and Capital Stock Section of the D.B.S.. A summary of recent revisions of and additions to the first estimates of capital flows and stocks has been written in "Fixed Capital Flows and Stocks: A Progress Report", *Canadian Statistical Review,* (February, 1970), Vol. 45, No. 2, pages 4-6.

Constant (1961) dollar figures for agricultural output and capital stock from 1947 to 1968 are employed in estimating the agricultural production function (Table A-2). As an estimation of labour input in agriculture, an index of man-hours employed in agriculture from 1947 to 1968 (Table A-2) has been used.

The trend and level of constant (1961) dollar agriculture output is derived from the index of real domestic product originating in agriculture (1961 = 100) (Table A-2). This series is adjusted for weather anomalies and other unexplained factors causing the marked fluctuations over the sample period by fitting a linear trend to the actual observations. This adjusted trend series of real agricultural output is regressed on real agricultural capital stock and man-hours of labour input to yield the estimated rate of technical change and the factor co-efficients of a Cobb-Douglas production function. The production relationship indicated by the regressions is assumed to continue to 1980.

The extrapolation of the agricultural capital stock series to 1980 is made on the basis of an adjusted two-year moving average. A two-year autoregressive equation indicates a significant trend ($R^2 = .99$) for the years 1949 to 1968; therefore, as a measure of movement over time, the projected growth in capital stock is estimated to be:

$$K_t = \alpha_1 + \alpha_2 K_{t-1} + \alpha_3 K_{t-2}, \text{ where } t = 1969, \ldots, 1980.$$

and
$$K_t = 411.7 + 1.586K_{t-1} - .622K_{t-2}$$
$$(152.0)\ (.144)\qquad (.132)$$

is the estimated relationship from 1949 to 1968. Standard deviations of the co-efficients are in parentheses.

The projection of labour-input in agriculture to 1980 is based upon the close relationship observed between man-hours of labour employed in agriculture and the level of employment of the total potential labour force over the post-war period, 1947 to 1968. As a measure of trend, the equation estimated is:

$$\log MHA_t = 20.7 - 1.85 \log ELF_t$$
$$(.72)\ (.08)$$

where ELF is the employed labour force, and MHA is the man-hours in agriculture. For the period 1969 to 1980 projections of the labour force have been established by the Economic Council of Canada Population Study.[19] The projected employed labour force series is derived by assuming, approximately, a 3 per cent unemployment rate of the potential labour force. This level of unemployment is the "full employment" level assumed throughout the study. The projected employed labour force is then used in the above equation to estimate agricultural labour-input for the years 1969 to 1980.

[19] Wolfgang M. Illing, *Population, Family, Household and Labour Force Growth to 1980,* Economic Council of Canada, Staff Study No. 19 (Ottawa: Queen's Printer, 1967), Table 4-2, pages 94-95.

Table A-2

Labour Input and Output in Agriculture

Year	Index of Man-Hours 1961=100	Constant (1961) Dollar Real Domestic Product Originating in Agriculture
		($ million)
1947	166.1	1355.6
1948	163.5	1399.7
1949	162.3	1319.1
1950	148.9	1442.2
1951	139.8	1645.9
1952	134.0	2015.2
1953	131.7	1841.9
1954	136.1	1414.9
1955	127.3	1746.2
1956	121.5	1854.1
1957	115.0	1559.3
1958	108.3	1729.5
1959	104.9	1674.8
1960	102.1	1752.3
1961	100.0	1519.8
1962	96.3	1841.9
1963	93.4	2063.8
1964	89.3	1858.7
1965	83.4	1949.9
1966	77.6	2209.8
1967	78.3	1859.2
1968	74.9	2028.9
1969	–	2206.7
	(1)	(2)

Notes: (1) *Canada Year Book, 1969,* Dominion Bureau of Statistics, (Ottawa: Queen's Printer, 1969), page 1107.

(2) Real domestic product originating in agriculture is derived from the indexes of real domestic product by industry found in *Indexes of Real Domestic Product by Industry* (1961 Base), Cat. No. 61-506, Dominion Bureau of Statistics, (Ottawa: Queen's Printer, 1968) for 1947–1967 and, 1970 *Annual Supplement to Monthly Index of Industrial Production,* Cat. No. 61-005, D.B.S. (Ottawa: Queen's Printer, April 1970) for the years 1968 and 1969. The level of real agricultural output in 1969 is included in the estimation of a weather-adjusted series but not in the production function regression.

(3) The 1961 weight of real domestic product originating in agriculture is 4.557 per cent of real gross domestic product.

Constant (1961) dollar future agricultural output is derived from the projections of factor inputs and the Cobb-Douglas production function, assuming the technical relationships described over the period 1947 to 1968 persist to 1980.

It should be noted that all that is required in the above procedure is an *index* of man-hours in agriculture, from 1947 to 1980 (Table A-3). However, the projection of private non-farm output has been based on an estimate of private non-farm employment. Therefore, projections of employment in agriculture and government are subtracted from the Economic Council of Canada total labour force projections in order to obtain the future private non-farm labour force.[20] The indices of man-hours and men employed in agriculture are therefore weighted by the actual level of agricultural employment in 1961 to derive the level of future employment in agriculture.

The estimated post-war relationship between the index of people employed in agriculture and the index of man-hours of labour employed in agriculture is described by equation four, below. Since the index of man-hours employed in agriculture to 1980 has been projected the derived relationship can be applied to obtain an estimate of the index of men employed in agriculture to 1980. The base of the indices of man-hours and of men employed in agriculture is 1961 and in that year agricultural employment was 681,000. Therefore the projected index of men employed in agriculture multiplied by 681,000 yields an estimate of the number of men employed in agriculture to 1980.

The estimated equations are as follows:

1. Estimated agricultural production function for 1947 to 1968 uses the labour series of Table A-2 and estimates of agricultural capital stocks provided by the D.B.S.

$$\begin{aligned} \log \text{Output}_t &= 6.64 + .009 \log L_t + .06 \log K_t + .0155t \\ &\quad (.08) \quad (0.1) \quad (.004) \quad (.0006) \\ R^2 &= .999 \\ DW &= .28 \end{aligned}$$

Standard deviations of the co-efficients are in parentheses.

2. Projection of labour input is made on the basis of the derived relationship,

$$\begin{aligned} \log L_t &= 20.7 - 1.85 \log ELF_t \\ &\quad (.72) \quad (.08) \\ t &= 1947, \ldots, 1968 \\ R^2 &= .961 \\ DW &= .42 \end{aligned}$$

[20] *Ibid.*

3. Projection of capital input is made on the basis of the estimated relationship,

$$K_t = 411.70 + 1.586K_{t-1} - .622K_{t-2}$$
$$\quad\quad (152.0) \quad (.44) \quad\quad (.132)$$
$$t = 1949, \ldots, 1968$$
$$R^2 = .999$$
$$DW = .95$$

4. The estimation of the number of men employed in agriculture to 1980 is derived from the following relationships,

$$\text{Index of people employed in agriculture}_t = \underset{(.10)}{1.44}\ \text{Index of MHA}_t^{\underset{(.02)}{.922}}$$

$$t = 1947, \ldots, 1968$$
$$R^2 = .988$$
$$DW = .32$$

The projected index of man-hours in agriculture is estimated above in equation two. From equation four the projected index of people employed in agriculture is derived. The number of men employed in time t = (index of men employed)$_t$ times 681,000 where t = 1969, . . ., 1980 and 681,000 equals the number of men employed in agriculture in 1961.

5. Endogenous Variables:

   a) output is constant (1961) dollar output

   b) L_t is index of man-hours employed in agriculture, 1947-1968

   c) K_t is constant (1961) dollar agricultural capital stock, 1949-1968

   d) total agricultural employment, 1947-1968

   e) index of agricultural employment, 1947-1968

   Exogenous Variables:

   f) t = time

g) employed labour force: derived from applying a 3 per cent unemployment rate to projections of the total labour force for 1969-1980

Pre-determined Variables:

h) K_{t-n}, n = 1,2 t = 1949

Table A-3

Projections of Labour and Output in the Agricultural Sector

Year	Index of Effective Labour Force Employed in Agriculture 1961=100	Agricultural Output in Constant (1961) Dollars ($ million)	Total Labour Force Employed in Agriculture (thousands)
1969	68	2,092	501
1970	64	2,125	471
1971	61	2,158	444
1972	57	2,192	421
1973	54	2,226	398
1974	51	2,760	378
1975	49	2,295	360
1976	46	2,330	344
1977	44	2,365	329
1978	42	2,402	315
1979	41	2,439	302
1980	39	2,476	291
	(1)	(2)	(3)

Notes: (1) The index on the effective labour force is estimated from equation 2 and is measured in man-hours.

(2) Projected agricultural output is derived from the Cobb-Douglas production function described by equation 1.

(3) Total labour force employed in agriculture is derived from equation 4.

(c) The Government and Residential Sectors

In this analysis it is assumed that the level of activity in the government sector and rents from residential property are independent of the level of activity in the rest of the economy.

It is difficult to find entirely satisfactory measures of either government employment or product for Canada. This continues to be so even with the valuable work contained in Richard Bird's study: *The Growth of Government Spending in Canada.* Bird has assembled a series for total government employment at the federal, provincial and municipal levels from 1961 to 1967. However, there is no complete data for earlier years.[21] R. G. Scott built his series of government employment from the Hood and Scott estimates for 1926 to 1955.[22] The Hood and Scott estimates are substantially lower than those for corresponding years used in this study.[23]

In the present study, government employment is estimated from tax return data (Table A-4). Government employment is taken as the number of employees in the federal, provincial and municipal governments, less post office employees. This data is found in *Taxation Statistics* (Ottawa: Queen's Printer) in the table titled "All Returns by Occupation", in editions from 1953 to 1970. Because postal services are included with the output of the transportation, storage and communication industries, postal workers are subtracted from the total number of government employees. Post Office employment includes both temporary and full time staff.

Except for 1951 and 1952, employment levels in the post office are as of the end of December. For these two years, the figures are for the end of March. The month in which casual employment is highest is November. Numbers of postal workers come from *Federal Government Employment,* D.B.S. catalogue number 72-004 and the earlier series, *Federal Civil Service Employment and Payrolls,* also 72-004. Government employment less postal workers is estimated from 1947 through 1950 by interpolation of a function of government employment over time.

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[21] Richard M. Bird, *The Growth of Government Spending in Canada* (Toronto: Canadian Tax Foundation, 1970) Table 50, page 299. Total government employment is given as follows:

	thousands		
1961	649	1964	744
1962	647	1965	773
1963	710	1966	818
		1967	852

[22] R. G. Scott, Appendix A, in, Wilson and Lithwick, *op. cit.*, page 241.

[23] W. C. Hood and A. D. Scott, *Output, Labour and Capital in the Canadian Economy* (Study for the Royal Commission on Canada's Economic Prospects), page 199.

The estimate of government employment in the Bird study exceeds that in this study by between 1 per cent and 10 per cent.[24]

Bird's data and the data derived from the tax statistics include employees of federal agencies, provincial government enterprises and Workmen's Compensation Boards. This data includes employees of federal proprietary corporations and employees of provincial institutes of higher education. The taxation statistics exclude crown corporations and include non-teaching employees of provincial institutes of higher education.

The quantity index of real domestic product at factor cost in public administration has not been used as a measure of real government product in this study. Rather, an index derived from constant dollar current expenditure of government in Gross National Expenditure and constant dollar government capital expenditure has been used. This index is then applied to the 1961 share of public administration in Gross Domestic Product. Lack of continuity and correspondence between the two D.B.S. indices of real product in public administration led to the decision to create an index of real government output from the revised national accounts. The government output index is derived from the sum of constant dollar government current expenditure on goods and services and government gross fixed capital formation. Government constant (1961) dollar current expenditure is from Table C, line 2, *National Income and Expenditure Accounts, 1926–1968* (Ottawa: Queen's Printer, 1968), pages 33-35. Government gross capital formation is in constant (1961) dollars as estimated by the National Wealth and Capital Stock Section of the Dominion Bureau of Statistics.

Residential rent in constant (1961) dollars is estimated from current dollar tenant and resident rent (Table A-5). The current dollar series is adjusted to constant dollars using the implicit shelter price index. This index is derived from 1949 constant dollar personal expenditure on shelter adjusted to a 1961 base. Estimates of gross capital stock for the economy exclude estimates of the capital stock of residential dwellings. The value of rent for 1968 was estimated by simple extrapolation using a derived functional relationship between rent and the series of G.D.P. in constant dollars. Current dollar residential rent is derived from current dollar tenant and resident rent. This is the sum of current gross rents paid by tenants and current net imputed capital consumption allowances, *National Accounts* (Ottawa: Queen's Printer), 1961 and 1967 annual editions, Table 47, lines 12 and 14. This is then adjusted to constant dollars using the implicit shelter price index. This index is derived from 1949 constant dollar personal expenditure on shelter adjusted to a 1961 base, *National Accounts* (Ottawa: Queen's Printer), 1961 and 1967 editions, Table 58, line 4; 1926–1956 summary edition, Table 48, line 4.

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[24] See footnote 21, above.

Table A-4

Total Government Employment

(thousands)

Year	Total Government Employment	Post Office Employment	Total Government
1947	–	–	(258)
1948	–	–	(274)
1949	–	–	(290)
1950	–	–	(308)
1951	332	22	310
1952	360	20	340
1953	398	20	379
1954	430	21	408
1955	438	22	416
1956	442	23	420
1957	487	24	463
1958	522	24	497
1959	547	25	521
1960	582	26	556
1961	619	27	592
1962	658	27	631
1963	678	28	650
1964	724	28	696
1965	759	29	730
1966	814	36	778
1967	875	39	836
1968	908	42	867

Source: Total government tax returns is tax returns of federal, provincial and municipal employees from *Taxation Statistics,* (Ottawa: Queen's Printer), editions 1953 to 1970. Postal employees are from *Federal Government Employment,* D.B.S. 72-004, various years.

Notes: See the text for a discussion of the coverage of the tax return and postal worker data. Government employment for 1947 through 1950 was an interpolation of government employment over time.

Table A-5

Residential Rents

Year	Implicit Shelter Price Index	Tenant and Resident Rent ($ million)	Constant Dollar Rent (1961=100)
1947	46.9	561	1,196
1948	49.6	593	1,196
1949	55.3	667	1,251
1950	56.5	789	1,397
1951	59.9	881	1,471
1952	62.4	996	1,596
1953	65.4	1,128	1,725
1954	68.2	1,307	1,916
1955	73.0	1,464	2,006
1956	75.9	1,489	1,962
1957	81.0	1,636	2,020
1958	85.6	1,757	2,053
1959	91.4	1,902	2,081
1960	94.8	1,963	2,071
1961	100.0	2,059	2,059
1962	104.5	2,086	1,996
1963	112.6	2,266	2,012
1964	119.0	2,375	1,996
1965	126.0	2,527	2,006
1966	134.2	2,691	2,005
1967	141.0	2,948	2,090

Sources: Implicit shelter price index is 1949 constant dollar personal expenditure on shelter adjusted for 1961=100. *National Accounts* (Ottawa: Queen's Printer) 1961 and 1967 annual editions, Table 58, line 4; 1926–1956 summary edition, Table 48, line 4. Tenant and resident rent is sum of current gross rents paid by tenants and current net imputed residential capital consumption allowances. *National Accounts* (Ottawa: Queen's Printer) 1961 and 1967 annual editions, Table 47, lines 12 and 14.

Note: Constant dollar tenant and resident rent is tenant and resident rent multiplied by 100 and divided by the implicit shelter price index. Rent for 1968 is derived by extrapolating the relationship between constant dollar G.D.P. and rent over the interval.

A.3 Historical Tests of the Technical Relationships

The growth of private non-farm output in projections of potential output is very sensitive to the rate of growth of the capital stock. The capital stock is generated iteratively in the projections and is a function of the assumed investment rate and the capital discard rate. Gross investment in each successive year is a function of estimated previous year Gross National Product. Gross capital stock is then previous year capital stock less the assumed proportion of the capital stock discarded each year plus gross investment. The stock of capital and the available labour supply together with the technical relationship between factor inputs and output described by the production function yield the estimated size of potential private non-farm output.

The projection of potential private non-farm output to 1980 requires the choice of a reasonable investment and capital discard rate. Between 1950 and 1968 gross fixed capital formation in the private non-farm sector has ranged between 13 and 18 per cent of previous year Gross National Product. Investment is sensitive to expectations about future economic prospects. These expectations may have on occasion precipitated a level of investment in excess of the sustainable capacity of the economy. The object is to select an investment rate consistent with sustainable full-employment growth. The one chosen is the investment rate which projects a potential output, starting from a 1947 base, identical to actual output by 1968. To test the sensitivity of growth to variations in the investment and discard rates, projections are simulated from 1947 to 1968 for a number of alternatives. To each of these alternative estimates of constant dollar private non-farm outputs is added actual constant dollar agricultural output, government expenditures and residential rents. Gross National product is then derived by multiplying Gross Domestic Product by 1.16, the lowest observed relation between the two aggregates in the 1947 and 1968 period. The assumption of a low multiplicative relationship between G.D.P. and G.N.P. will tend to bias constant dollar estimates of G.N.P. downward slightly.

Table A-6 shows projections of constant (1961) dollar G.N.P. for various investment and discard rates. For a projection over the period 1947 to 1968 a one per cent difference in investment rate makes a difference of about 1.6 per cent in G.N.P. at the end of 22 periods. Table A-7 shows the corresponding sensitivity of 1968 capital stock to various investment and discard rates.

Table A-6

Sensitivity of Estimated 1968 Maintained Full-Employment Gross National Product to Alternative Assumptions

(constant (1961) dollars–million)

XINV \ DIS	.03	.025	.02
13.5	56,599	57,462	58,352
14.0	57,076	57,939	58,830
14.5	57,545	58,410	59,302

Source: Sensitivity tests of G.N.P. to various investment and discard rates given the estimated parameters of the private non-farm production function and full employment.

Notes: "XINV" is gross investment in the private non-farm sector as a per cent of previous year's G.N.P.. "DIS" is the per cent of gross capital stock of the private non-farm sector assumed to be discarded each year. Optimal utilization of capital and labour is assumed to be consistent with 3.5 per cent unemployment in the private non-farm sector or 2.8 per cent unemployment of the civilian labour force. Our procedure for deriving actual constant (1961) dollar G.N.P. for 1968 from G.D.P. for 1961 yields a value of $56,998 million. The (1961) dollar figure for 1968 published in the revised National Accounts is $58,041 million. See, *National Income and Expenditure, 1926–1968* (Ottawa: Queen's Printer, 1969), page 35.

Table A-7

Sensitivity of Estimated 1968 Maintained Full-Employment Gross Capital Stock to Alternative Assumptions

(constant (1961) dollars—million)

XINV \ DIS	.03	.025	.02
13.5	97,662	103,768	110,341
14.0	100,999	107,259	113,995
14.5	104,364	110,779	117,679

Source: Sensitivity tests of G.N.P. to various investment and discard rates given the estimated parameters of the private non-farm production function and full employment.

Notes: "XINV" is gross investment in the private non-farm sector as a per cent of previous year's G.N.P.. "DIS" is the per cent of gross capital stock of the private non-farm sector assumed to be discarded each year. Optimal utilization of capital and labour is assumed to be consistent with 3.5 per cent unemployment in the private non-farm sector or 2.8 per cent unemployment of the civilian labour force. The D.B.S. estimate for 1968 of gross capital stock for the total economy less agricultural and government capital, and excluding residential capital is $116,305 million for the assumed mid-life span of capital stock.

Table A-8

Comparison of Actual Gross National Expenditure Derived Gross National Product and Estimated Full-Employment Gross National Product

1947–1968

(constant (1961) dollars–million)

Year	Gross National Expenditure	G.N.P. Derived from G.D.P.	Estimated Full Employment G.N.P.
1947	20,861	20,728	20,728
1948	21,374	21,208	21,433
1949	22,119	22,912	22,179
1950	23,809	23,583	23,684
1951	25,004	24,685	25,532
1952	27,398	27,417	27,670
1953	28,862	28,926	28,620
1954	28,283	28,179	29,165
1955	31,079	30,965	31,093
1956	33,780	33,719	32,940
1957	34,710	34,439	34,835
1958	35,462	35,400	36,124
1959	36,929	36,656	37,457
1960	37,994	37,727	39,282
1961	39,080	38,687	40,715
1962	41,778	41,062	42,561
1963	43,996	43,306	44,583
1964	47,050	46,350	46,455
1965	50,149	49,473	48,965
1966	53,650	53,043	52,384
1967	55,407	54,518	54,633
1968	58,041	56,998	57,939

Source: Constant dollar Gross National Expenditure is from *National Income and Expenditure 1926–1968.* (Ottawa: Queen's Printer, 1969), page 33-35. Gross National Product is derived from Gross Domestic Product as follows: 1961 G.D.P. is the base which is multiplied by an index derived from constant dollar G.N.E.. The index is of constant dollar G.N.E. less net interest and dividends paid to foreigners and residual errors of estimate. This series is then multiplied by a "blow up" factor which represents the average relationship between G.N.E. and our estimate of constant dollar G.D.P.. G.N.E./G.D.P. in constant dollars has values which range from 1.16 to 1.18. We have used a "blow up" from G.D.P. to G.N.P. of 1.16.

Notes: Estimated full-employment G.N.P. is derived assuming optimal utilization of capital and labour in the private non-farm sector as consistent with 3.5 per cent unemployment of labour in this sector. The derivation further assumes a gross investment rate in the private non-farm sector of approximately 14.0 per cent of previous year's G.N.P. and a capital stock discard rate in the sector of 2.5 per cent per annum. Estimated gross domestic product is then estimated private non-farm output plus agricultural and government product. This is then transformed to a G.N.P. basis using the "blow up" factor of 1.16. The capital stock estimated for 1968 in the private non-farm sector is $106,704 million. This compares with the D.B.S. capital stock of $116,305 million.

Employing an investment rate of 14.0 per cent and a capital discard rate of 2.5 per cent over the post-war period yields a capital stock for the private non-farm sector 8.4 per cent below the D.B.S. estimate of the capital stock of this sector for 1968. For the same year, these assumptions give an estimated G.N.P. of $57,939 million in constant (1961) dollars. This is within one per cent of the National Accounts G.N.E. for 1968 of $58,041 million. The comparison of the revised National Accounts series for constant dollar G.N.E. and estimated G.N.P. with these assumptions is shown in Table A-8.

A.4 The Projection of Potential G.N.P. to 1975 and 1980

Potential G.N.P. in (1961) constant dollars in 1975 is estimated to be $85,772 million and in 1980 to be $110,239 million. An annual rate of inflation of 2.5 per cent is assumed in order to derive currect dollar estimates. Table A-9 shows potential G.N.P. to 1980 in constant and current dollars with 2.5 per cent per year inflation.

To project potential G.N.P. to 1980, the anticipated performance of the agriculture and government sectors is estimated in addition to maintained full-employment growth within the private non-farm sector. The anticipated growth of residential rents is also estimated.

The civilian labour force to 1980 is that estimated by the Economic Council of Canada.[25] From this is subtracted anticipated agricultural and government employment. To derive private non-farm employment 96.5 per cent of the balance of the civilian labour force is calculated. This series is then adjusted for the anticipated change in the average work week to derive the effective work force. Government employment as a proportion of the civilian labour force has grown from about 5 per cent in 1947 to almost 11 per cent in 1968. In the projection it is assumed that government employment will stabilize as a proportion of the civilian labour force at about 11.0 per cent from 1967 to 1980.

Government expenditure between 1967 and 1980 is assumed to grow in real terms at the rate anticipated by the Economic Council of Canada for the period 1967 to 1975. This is 7.1 per cent real growth per year.[26] This implies a constant dollar elasticity of government expenditure with respect to G.N.P. of 1.31 between 1967 and 1980.

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[25] Wolfgang M. Illing, *op. cit.*, Table 4-2, pages 94-95.

[26] Economic Council of Canada, *Sixth Annual Review: Perspective 1975* (Ottawa: Queen's Printer, 1969), page 32. If inflation in the government sector is expected to be higher than average, and is, say, 5.5 per cent per annum, average inflation of 2.5 per cent for the entire economy implies 1.35 per cent inflation for the non-government sector. With 5.5 per cent inflation, current dollar growth of the government sector is 12.6 per cent per annum.

Table A-9

Projected Maintained Full-Employment Growth

1967 – 1980

Gross National Product

(constant (1961) dollars–million)

Year	1961 Dollars	2.5 Inflation
1967	55,407	65,721
1968	59,163	72,984
1969	62,188	79,937
1970	65,731	86,603
1971	69,383	93,699
1972	73,187	101,306
1973	77,210	109,545
1974	81,396	118,371
1975	85,772	127,852
1976	90,249	137,888
1977	94,945	148,688
1978	99,887	160,337
1979	104,966	172,701
1980	110,239	185,910

Source: Gross National Product is estimated Gross Domestic Product "blown up" by 1.16, the lowest factor consistent with the observed relationship between Gross National Product and Gross Domestic Product from 1947 to 1968. Gross Domestic Product is the sum of the estimated product in agriculture, government, the private non-farm sector and rent.

Notes: The projected product of the private non-farm sector is the potential product of the sector assuming the factor inputs retain the same relationship to output that they would have had under optimal utilization of the factors for the period 1947 to 1968. Optimal utilization of labour is assumed consistent with 3.5 per cent unemployment in the private non-farm sector or 2.8 per cent unemployment in the civilian labour force. The effective private non-farm labour force from 1969 to 1980 is the civilian labour force projected by the Economic Council of Canada with a medium immigration assumption less estimated employment in agriculture and government, less assumed unemployed, and adjusted for for anticipated changes in the average number of hours in the manufacturing sector work week. The Economic Council's civilian labour force projection is taken from Staff Study No. 19 by Wolfgang M. Illing, *Population, Family, Household and Labour Force Growth to 1980,* Economic Council of Canada (Ottawa: Queen's Printer, 1967) pages 98-99. The P.N.F. projected gross capital stock is formed iteratively. The current year's gross capital stock is the previous year's capital stock less the per cent of stock assumed discarded each year plus new gross investment in the P.N.F. sector as a per cent of last period's G.N.P..

The investment rate in the private non-farm sector for gross investment is assumed to be 14.0 per cent of last period's G.N.P. and the discard rate is assumed to be 2.5 per cent of last period's P.N.F. capital stock.

Table A-10

Sensitivity of Estimated 1980 Maintained Full-Employment Gross National Product To Alternative Assumptions

(constant (1961) dollars—million)

XINV \ DIS	.03	.025	.02
13.5	108,226	109,535	110,869
14.0	108,930	110,239	111,571
14.5	109,628	110,935	112,265

Source: Constant dollar G.N.P. is constant dollar G.D.P. adjusted by the lowest factor consistent with the observed relationship between Gross National Product and Gross Domestic Product from 1947 to 1968. Gross Domestic Product is the sum of anticipated product in agriculture and private non-farm sector, government expenditure and residential rents.

Notes: "XINV" is gross investment in the private non-farm sector as a per cent of previous year's G.N.P.. "DIS" is the per cent of gross capital stock of the private non-farm sector assumed to be discarded each year. Optimal utilization of capital and labour is assumed to be consistent with 3.5 per cent unemployment in the private non-farm sector or 2.8 per cent unemployment of the civilian labour force. Output from and labour force required by the agricultural sector is estimated independently employing the production function procedure described in section A-2(b) on the agricultural sector. Government expenditure is taken as $3,285 million in 1967 and assumed to grow at 7.1 per cent per annum in real terms. This real rate of growth is that indicated by the Economic Council for the period 1967 to 1975 in *Perspective 1975* (Ottawa: Queen's Printer, 1969), page 32.

The government labour force is assumed to continue as 10.95 per cent of the civilian labour force, the proportion attained in 1968. The effective private non-farm labour force is the civilian labour force projected by the Economic Council of Canada with the medium immigration assumption less estimated employment in agriculture and government, less assumed unemployment and adjusted for anticipated changes in the average number of hours in the manufacturing sector work week.

Table A-11

Sensitivity of Estimated 1980 Maintained Full-Equipment Gross Capital Stock to Alternative Assumptions

(constant (1961) dollars–million)

XINV \ DIS	.03	.025	.02
13.5	190,607	199,572	209,004
14.0	195,397	204,512	214,098
14.5	200,218	209,482	219,223

Source: Sensitivity tests of gross 1980 capital stock to various gross investment and gross capital stock discard rates.

Notes: "XINV" is gross investment in the private non-farm sector as a per cent of previous year's G.N.P.. "DIS" is the per cent of gross capital stock of the private non-farm sector assumed to be discarded each year.

The relationship of P.N.F. output to the P.N.F. labour force and capital stock from 1969 to 1980, is assumed to be that found for the P.N.F. sector between 1947 and 1968 as indicated by the production function.

For the period 1953 to 1965, Richard Bird estimates the constant dollar elasticity of General Government, Protection and Other with respect to G.N.E. as 1.37.[27]

Constant dollar residential rents as a proportion of previous year G.D.P., net of rents, has declined from about 7 per cent in 1947 to just under 5 per cent in 1966. For the projection to 1980 it has been assumed that rent will continue to be 5 per cent of estimated previous year G.D.P.

[27] Bird's current dollar elasticity is 1.50 for Government, Protection and Other between 1953 and 1956. Richard Bird, *op. cit.*, Appendix C, Table 32, page 278. With average inflation within the government sector of 5.5 per cent, the current dollar elasticity of government expenditure is 1.37 between 1967 and 1975 and between 1967 and 1980, 1.95. In the present study, with inflation in the government sector at the average of 2.5 per cent per year for the economy, the current dollar elasticity of government expenditure is 1.08 between 1967 and 1975 and 1.16 between 1967 and 1980.

The private non-farm sector is estimated asssuming the production function derived for 1947 to 1968 to be applicable over the projection period. In generating the capital stock for each successive year, the investment rate for the private non-farm sector is assumed to be 14.0 per cent of the previous year G.N.P. and the discard rate of capital is assumed to be 2.5 per cent per annum. Table A-10 shows the sensitivity of constant (1961) dollar estimates of G.N.P. to various combinations of the discard rate of capital and the investment rate. Table A-11 shows the corresponding sensitivity of the capital stock estimates.

Current dollar G.N.P. for 1968 and for 1969 is estimated using the actual inflation rates of 4.0 per cent and 4.2 per cent respectively. For the remainder of the projection period, the inflation rate chosen is governed by the desire to select the minimum credible current dollar G.N.P.. This is to minimize the discrepancies between the revenue implications of the current system and that proposed in the federal white paper on tax reform. Were it not for this consideration, the procedure would be to determine the appropriate rate of inflation for the employment level estimated. This might be derived by fitting a curve of the relation between G.N.P. inflation and the employment rate over the 1947 to 1968 period. The drawback to this procedure is that it assumes the institutional and market structures will remain throughout the projection period as they were in the past. Recent evidence indicates that the relationship between employment rates and the G.N.P. inflation rate has changed in recent years. The choice of 2.5 per cent inflation implicity assumes that public policy succeeds in reconciling full employment with moderately rising prices. The less successful policy proves to be in keeping inflation down, the greater will be the growth in current dollar G.N.P., and, as the tax analysis shows, the more exaggerated are the revenue differences between the current system and that proposed by the federal government.

Table A-12

Sensitivity of Estimates of Current Dollar G.N.P. to Assumed Inflation Rates

($ million)

Inflation at:	2.0%	2.5%	3.0%
1975	124,156	127,852	131,640
1980	176,174	185,910	196,133

Source: Sensitivity tests of G.N.P. to various assumed inflation rates for a gross private non-farm investment rate of 14.0 per cent of previous year's G.N.P. and discard rate of gross capital stock of 2.5 per cent.

A.5 Summary

For this study G.N.P. at potential output has been projected to 1980 using one of several possible procedures. In general, the method follows that employed in *The Sources of Economic Growth,* Staff Study 24 for the Royal Commission on Taxation. Central to this approach is the specification and estimation of the technical production relationship between factor inputs and final output for two of the four principal domestic sectors of the economy.

The Economic Council of Canada has also projected potential G.N.P. to 1975.[28] The Council follows the method developed by Edward Denison to estimate and project changes in total factor productivity. The Denison analysis of factor productivity involves a breakdown of national income in current dollars among returns to the separate factors of production. This breakdown provides weights to combine the various factors and compare their importance. The contribution to growth in output of each factor is measured by the growth in the factor itself weighted to reflect its share in Net National Income. The residual growth of output is then a measure of changing factor productivity.[29]

The research underlying the Economic Council's projection is described in two staff studies by Dorothy Walters.[30] Differences in the results of the Economic Council's projections and those in this study may be attributed to a number of considerations. There are differences in the methods used, differences in the base periods analyzed, differences in the statistical series used, as well as differences in the level of aggregation. The Economic Council's analysis is based on a method which derives total factor productivity. Its analysis covers the period 1950 to 1967 and examines factor contributions to Net National Income for the entire economy. The analysis of the present study covers the period 1947 to 1968, breaks the ecomomy into four sectors, and, for two of these, examines the relationship between output and input with the aid of an explicit production function. The Economic Council's method estimates the change in factor productivity for the entire economy. In this study, the change in factor productivity is attributed entirely to the private non-farm sector.

Both this study and the analysis underlying *Perspective 1975,*[31] by the Economic Council use the latest revisions to the National Accounts wherever possible.[32] However, there are a number of important differences in the methods of measurement used in the two

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[28] Economic Council of Canada, *Sixth Annual Review, op. cit.*, page 17.

[29] Edward F. Denison, *The Sources of Economic Growth in the United States and the Alternatives Before Us* Committee for Economic Development, Supplementary Paper 13 (New York, 1962), page 25.

[30] Dorothy Walters, *Canadian Income Levels and Growth,* Economic Council of Canada, Staff Study No. 23 (Ottawa: Queen's Printer, 1968) and *Canadian Growth Revisited, 1950-1967,* Economic Council of Canada, Staff Study No. 28 (Ottawa: Queen's Printer, 1970).

[31] Economic Council of Canada, *Sixth Annual Review, op. cit.*

[32] *National Income and Expenditure Accounts, 1926–1968,* Dominion Bureau of Statistics (Ottawa: Queen's Printer, August, 1969).

analyses. Both studies adjust the employed labour force for hours worked, but do so in different ways. This study adjusts for changes in average weekly hours as is estimated they would have been, given full employment between 1947 and 1968. The Economic Council's work adjusts for actual changes in hours and makes some attempt to account for separate changes of male and female hours.[33] In addition, the Economic Council adjusts the labour force for changes in its composition by age, sex and education. The present study assumes the private non-farm capital stock to be homogeneous. The Economic Council makes allowances for changes in its composition between non-residential construction, and machinery and equipment.

In the course of the analysis it has been found that in some instances there was little to choose between alternative measures of some of the components of either the output of a particular sector, or the inputs.[34] In most cases where plausible alternatives exist, the calculations have been made to learn their influence on the results. Because the objective of this study is to project potential G.N.P. rather than arrive at the single-valued best estimate of the rate of change of factor productivity, it is important both to have some idea of the range in which the value of total factor productivity change may be expected to lie, and to realize that when projections are made with data consistent with that used over the interval from which the parameters are estimated, variations in the parameters will be offset by the corresponding variations in the series used for the projection.

In this study, the best estimate of the rate of change of factor productivity in the private non-farm sector is 1.8 per cent a year. The true value may be expected to lie between 1.6 and 2.0 with about 99 per cent confidence. The estimated values derived from the alternative possible series are well within this range. The estimate in Staff Study 24 of the Royal Commission on Taxation is 1.97 per cent a year derived for the time interval 1926 to 1963.

In the projection of G.N.P. to 1980 the present study assumes that the growth of factor productivity in the private non-farm sector will continue at the same rate as in the 1947 to 1968 interval. The Economic Council estimates factor productivity growth for the entire economy at 2 per cent a year from 1955 to 1967 and from 1960 to 1967. In its projection from 1967 to 1975 it assumes productivity growth for the entire economy to

[33] Dorothy Walters, *Canadian Income Levels and Growth, op. cit.*, page 205.

[34] The controversy between D. W. Jorgenson and F. Griliches on the one hand and Edward Denison on the other about the appropriate measure for changing factor productivity assumes equivalent procedure and is primarily about differences in measurement, weighting and aggregation. The controversy illustrates how small changes in measurement can make relatively important differences to the per cent change in factor productivity. The controversy is over single-valued estimates. It is more instructive to know the range within which the true value may be expected to lie with a given level of confidence. Edward F. Denison, "Some Major Issues in Productivity Analysis" in *Survey of Current Business*, (Washington, U.S. Department of Commerce, May 1969), Vol. 49, No. 5, Part II, and D. W. Jorgenson and F. Griliches, "The Explanation of Productivity Change", *Review of Economic Studies*, Vol. 34, No. 3, (July 1967).

decline to 1.8 per cent.[35] Because this study and the Economic Council estimate productivity changes for different aggregates of the economy, the two rates of productivity change, though identical, are not comparable.

This study projects output on the basis of independent estimates of factor inputs to the target year. The two principal factors are labour and capital. The projected labour force is derived by the Economic Council from demographic estimates and assumptions about immigration and labour force participation rates. The effective labour force is then found by adjusting the employed labour force for the anticipated secular decline of the average work week at full employment. The projected labour force in the private non-farm sector is the total labour force less the anticipated agricultural work force and the assumed level of government employment. Two procedures are used for projecting the capital stock. In the agricultural sector, projected capital stock is a moving average of past capital. In the private non-farm sector, capital in any year is the previous year's capital plus new investment less capital discarded. The capital input is generated iteratively. It requires knowledge of the previous year's projected G.N.P. and capital stock and assumptions about the investment and capital discard rates.

The Economic Council estimates potential G.N.P. in Canada in 1975 at $100.7 billion in constant (1967) dollars. This study estimates potential G.N.P. in 1975 at $101.6 billion in constant (1967) dollars or $85.8 billion in constant (1961) dollars. Assuming a price inflation of G.N.P. of 2 per cent a year, the Economic Council estimates 1975 potential G.N.P. at $120 billion in current dollars.[36] This study estimates 1975 current dollar potential G.N.P. with 2 per cent inflation at $124 billion. However, unlike the Economic Council projection, allowance has been made for actual inflation between 1967–1968 of 4 per cent and 1968–1969 of 4.2 per cent. For the revenue estimates inflation is assumed to be 2.5 per cent per year. At this level of inflation, potential G.N.P. would be $127.9 billion in 1975 and $185.9 billion in 1980.

The projection to 1980 in this study implies that between 1967 and 1980 potential G.N.P. in constant dollars will grow at 5.4 per cent per year. Between 1967 and 1975 the growth of G.N.P. is 5.6 per cent per year and between 1975 and 1980, 5.1 per cent per year. This compares to the estimate of 5.5 per cent to 1975 by the Economic Council.[37]

The projection to 1980 implies that between 1968 and 1975 the employed labour force will grow at 2.78 per cent per year. Between 1968 and 1980 the labour force will grow on average at 2.58 per cent per year. The Economic Council projects the labour force will grow at 2.8 per cent per year between 1967 and 1975.

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[35] Economic Council of Canada, *Sixth Annual Review, op. cit.*, page 12.

[36] *op. cit.*, page 11.

[37] *op. cit.*, page 12.

Over the interval, 1947 to 1968, the private non-farm capital stock grew at 5.49 per cent per year. In the test between 1947 and 1968 the capital stock grows at 5.05 per cent per year assuming a discard rate of 2.5 per cent and an investment rate of 14 per cent. With these assumptions, over the interval 1967 to 1980 capital will grow at 4.9 per cent per year, 4.8 per cent between 1967 and 1975 and 5.0 per cent between 1975 and 1980.

From 1967 and 1975 the Economic Council projects the average growth of the capital stock for business structures and equipment to be 5.8 per cent a year. The estimate of this study using an investment rate of 14.0 per cent and a discard rate of 2.5 per cent over the 1961 to 1967 interval yields a growth rate of the private non-farm capital stock of 4.9 per cent. The actual growth in the capital stock of the private non-farm sector over this interval was 5.2 per cent a year.

The estimate of potential output in 1980 used in the revenue estimates of this study is low. The projection to 1980 uses an investment rate of 14 per cent and a capital discard rate of 2.5 per cent. The same assumptions for a projection from 1947 to 1968 yield a capital stock which is 92 per cent of the actual capital stock but an output well within one per cent of actual G.N.P. for 1968. Because the projection between 1947 and 1968 assumes maintained full employment, the resulting greater supply of labour must be offset by a smaller capital stock to produce the same 1968 output.

The investment rate which produces the actual 1968 capital stock in a projection from 1947, assuming full employment, is 15.5 per cent; it yields a 1968 G.N.P. which is about 2.0 per cent higher than the actual level. This investment rate in a projection from 1967 to 1980 yields a constant dollar G.N.P. 15 per cent higher than that used for the revenue estimates in this study.

Had a maintained full employment policy in fact been successfully carried out after 1947, expectations about the future performance of the economy would have been both more optimistic and less uncertain. This would be expected to yield an even higher level of investment and therefore an even higher capital stock than actually existed by 1968. However, there is no way of knowing what this sustainably higher investment rate might have been. The investment rate approached 18 per cent in 1956 and 1957 but the subsequent downturn in the economy is some indication that this exceeds the sustainable level.

Potential output for 1975 and 1980 is also estimated using 1969 as a base year rather than 1967. The 1969 capital stock is that generated from the 1968 capital stock assuming an investment rate of 14 per cent and a capital discard rate of 2.5 per cent. The purpose of

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[38] *op. cit.*, page 11.

this test was to determine the effect of the actual performance of the economy in 1968 and 1969 on this projection. The 1969 based projection yields a current dollar estimate for 1980 which is 0.2 per cent higher than that based on 1967. This is chiefly due to the conservative investment rate of 14 per cent. The capital stock in the estimate is sufficiently lower than the actual growth in the stock between 1967 and 1969 to offset the assumed higher than actual level of employment. This two year comparison is an illustration of the conservative nature of the estimates presented in this study.

APPENDIX B

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PROJECTIONS OF THE TAXFILING POPULATION AND OF RELATIVE SHARES OF INCOME SOURCES

A procedure different from that employed in predicting the tax return sample for 1969 from the 1967 sample has been used in the extrapolation to 1975 and 1980. The difference is primarily one of level of aggregation. The method of the present study employs a further breakdown of tax returns into age, sex, and occupation classifications. It is the purpose of this appendix to explain the technique in terms of the mathematical and statistical properties of the model, and to examine the adequacy of it in the light of the historical trends of the economy.

B.1 The Estimation Procedure

Two potential methodologies compete where a basis is sought for projecting the economic patterns of the future. The first possible method is a behavioural model, one which, by means of simultaneous regression techniques, would predict the movements of the sample in reaction to differences between the present and various proposed tax systems and would incorporate the resultant shifts into the distribution of taxfilers, reflecting the secular movements in tax return filing patterns in the economy. The second method is simpler. It is a trend analysis, wherein the components are estimated as a simple function of some variable with which they move over time. The second method has been chosen for two reasons. The nature of the tax analyzer, the basic model, is essentially non-interactive and precludes a sufficiently complete analysis of future behavioural patterns. Secondly, when projecting, the complexity of the model is severely restricted by the lack of suitable exogenous variables with which to properly identify the system for estimation purposes. The trend analysis, on the other hand, offers a technique which employs simple regressions, and relies on the high correlation of certain variables through time. A priori reflection suggests, and empirical observation confirms, the existence of such trends and, to the extent to which they reflect basic shifts in social patterns, reasonably independent of minor changes in the tax system, it is legitimate to hypothesize their continuance into the next decade.

However, a problem exists in simple trend analysis due to the rigidity of the functional form of the regression equation. A simple linear regression on an independent variable such as time, as is often used, has difficulty coping with non-linear trends where all derivatives, not only the first, exist and are nonzero over the relevant range. Thus the functional form used was:

$$X = \alpha_1 Y^{\alpha_2} \quad , \alpha_1 > 0$$

such that

$$X' = \alpha_1 \alpha_2 Y^{\alpha_2 - 1}$$

which implies that X is an increasing/constant/decreasing function of Y as α_2 is greater than zero/zero/less than zero. Also:

$$X'' = \alpha_1 \alpha_2 (\alpha_2 - 1) Y^{\alpha_2 - 2}$$

which implies that X as a function of Y is concave from above/linear and increasing/convex but monotonically increasing as α_2 is greater than one/one/less than one, for α_2 greater than zero, and decreasing at a decreasing rate with $\hat{X} = 0$ as an asymptote, for α_2 less than zero. While the properties of $\hat{X}$ may not be well-behaved as Y becomes arbitrarily large, over the sample of finite values of possible Y's, the function's variability makes it ideal in estimating the types of trends in the tax returning population and the components of national income.

Statistically, the parameters are estimated using a logarithmic transformation of the basic data,

i.e. $$X_t = \alpha_1 Y_t^{\alpha_2} u_t$$

if, and only if, $$\log X_t = \log \alpha_1 + \alpha_2 \log Y_t + \log u_t$$

If U_t is assumed to be log-normal by calling upon the multiplicative central limit theorem, then $\log U_t$ is normally distributed with mean zero, and the coefficients can be estimated, using simple least squares. Generally, however, some of the assumptions of the general linear model break down in a regression of time series data causing a non-optimalization of estimation with respect to certain statistical indicators. For the techniques to be applicable the error terms must not be correlated. When serial correlation exists, as it often does in this particular series of estimations, reference to the Durbin–Watson statistic indicates that the off-diagonal elements of the variance/covariance matrix of the disturbance terms are non-zero. If this knowledge were not incorporated into the model estimates would be obtained which were both biased and inefficient. To correct, assuming first-order autocorrelation[1]:

$$\log u_t = \varphi \log u_{t-1} + \log \epsilon_t$$

or, more generally:

$$\log u_t = \varphi^n \log u_{t-n} + \sum_{k=0}^{n} \varphi^K \log \epsilon_{t-k}$$

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[1] The error term, $\sum_{k=0}^{n} \varphi^k \log \epsilon_{t-k}$ is normal because of the multiplicative central limit theorem, and has mean,

$$E\left[\sum_{k=0}^{n} \varphi^k \log \epsilon_{t-k}\right] = \sum_{k=0}^{n} \varphi^k \log E(\epsilon_{t-k}) = \sum_{k=0}^{n} \varphi^k \log 1 = 0$$

which is consistent with the assumptions of the general linear model. When it is incorporated into the model, as above, it yields predictions which are unbiased, since $\hat{\alpha}_1, \hat{\alpha}_2, \varphi$ are unbiased when using ordinary least squares, and are statistically efficient.

where the disturbances ϵ_t are assumed to conform to the assumptions of the general linear model. With the incorporation of this structure, the prediction equation becomes:

$$\log X_t = \log \hat{\alpha}_1 + \hat{\alpha}_2 \log Y_t + \varphi^n \log u_{t-n}$$

if, and only if, $X_t = \hat{\alpha}_1 Y_t^{\hat{\alpha}_2} u_{t-n}^{\varphi^n}$

B.2 The Extrapolation of the Numbers and Distribution of Returns

The blow-up of numbers of taxfilers is approached in a manner different from that employed in the blow-up of sources of income. The technique involved in the extrapolation begins from a theoretical position which is modified in the light of data restrictions and the structure of the tax analyzer. These must be examined as possible sources of bias in the predictions.

In its most complete theoretical form the model uses a breakdown of the tax filing sample according to age, occupation and sex characteristics into cell collections of individuals exhibiting similar characteristics. Time series regressions are then run on this cross-sectional pattern, so that the entire population may be projected through time. Each cell is estimated with the number of tax returns (NTR) as the independent variable. The exogenous variable in the system, upon which the number of taxfilers is regressed, is the employed labour force (ELF). The employed labour force figures are estimates produced in the Economic Council of Canada study by Wolfgang M. Illing[2] and assume maintained full employment.

The system may be represented symbolically: let the number of people in a cell be represented by X_{ijk}, where i refers to age classification, j the occupation, and k the sex characteristics with n_1, n_2, and n_3 units respectively.

Then $\sum_{i=1}^{n_1} \sum_{j=1}^{n_2} \sum_{k=1}^{n_3} X_{ijk}$, represents the entire population. For purposes of notational simplicity, let $X = X_{ijk}$ be a three dimensional array representing the population sample.

The projected cell population, as a function of the number of tax returns can be represented as:

$$\hat{X}_{ijk} = f_{ijk}(NTR_t)$$

where the function f_{ijk} is determined by a simple regression using the form described above.

[2]Wolfgang M. Illing, *op. cit.*

When projecting from t=0 as a base year, a ratio

$$Y^t_{ijk} = \frac{f_{ijk}(NTR)}{X^{to}_{ijk}}$$, can be used as a multiple on X^{to}_{ijk}

to extrapolate to year t. If $Y^t = (Y^t_{ijk})$ is set up as a three dimensional array, similar to X, then

$X^t = Y^t * X^{to}$, where the operator, $*$, is defined as

$(X_{ijk}) * (Y_{ijk}) = (X_{ijk} \cdot Y_{ijk})$

i.e. simple multiplication of corresponding cells.

However this method faces two constraints. Both data sets, those upon which the estimation is made, and those which are to be extrapolated, must be divisible into the X_{ijk} classifications. Also, the method requires $n_1 \cdot n_2 \cdot n_3$ regressions to project the tax sample. If data may be aggregated, or if it may be generated in a more concise manner, without significant information loss, then the technique can be contracted from its most generalized form.

The second problem, that of inefficient use of regressions, can be overcome by assuming *independence* among the three factors for a given individual. That is, the function f_{ijk} may be represented as a simple product of its three marginal components, such that

$$f_{ijk} = f_i \cdot f_j \cdot f_k .$$

A Y-array generated in this manner, would require only $n_1 + n_2 + n_3$ regressions, and under the condition of complete independence, where the equation holds exactly, would cause no information loss. Bias, as a result of a breakdown of the independence assumption, would exist to the extent that differences in behaviour of groups of people, differing only in one classification, could not be explained by the general function of that characteristic, and the

resultant sampling error would vary directly as the square of the difference between the actual f_{ijk} parameters and the parameters computed under the above formula.[3]

Under the assumption of independence the model becomes $X^t = Y^t * X^{to}$. Given the estimation technique each marginal function includes information about the general taxfiler increase, as well as the effect of the appropriate characteristics on the filing patterns. Thus the matrix Y must be *normalized* to adjust for the misestimation. This bias is one of absolute level, not distribution, and thus the normalization procedure will retain the proper relative weights in the corrected sample projection. Let N be the normalization factor. Then

$$X^t = Y^t * X^{to} \quad \text{where } Y^t = f_i \cdot f_j \cdot f_k \cdot N.$$

The normalization factor is derived in the following way. Given NTR_t, the taxfiling population as estimated by the regression on the employed labour force, the extrapolation is constrained by:

$$\sum_i \sum_j \sum_k Y^t_{ijk} \cdot X^{to}_{ijk} = NTR_t$$

if and only if,

$$N = \frac{NTR_t}{\sum_i \sum_j \sum_k Y^t_{ijk} \cdot X^{to}_{ijk}}$$

The first constraint to this optimal method of estimation, that of organization of data, necessitates that the matrices be collapsed from a three dimensional form to a vector. The

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[3] This concept is best illustrated by using the statistical technique of "analysis of variance" where the object is to explain those factors which cause deviations from the mean. The procedure used was a factorial experiment design which is represented, in two dimensions, by the model

$$Y_{tij} = u + \alpha_i + \beta_j + \lambda_{ij} + \epsilon_{tij},$$
$$\Sigma\alpha_i = \Sigma\beta_j = \Sigma\lambda_{ij} = 0$$

where α_i represents the influence of the rows, β_j the columns, and λ_{ij} the interaction of the two. For the model u represents the general population inflator, α_i and β_j and λ_{ij}, the influence of the various factors. The basic data undergoes two transformations: one, a logarithmic transformation to make the effects additive, since the model is multiplicative, and two, an appropriate orthonormalization to put the data in a form for an analysis of variance. This being done, the sums of squares may be examined to discover the sources of variation.

The variance $\Sigma (Y_{tij} - \bar{Y})^2$

may be broken down into variance due to rows $TJ\Sigma_i (\bar{Y}_{\cdot i \cdot} - \bar{Y})^2$

variance due to columns $TK\Sigma_j(\bar{Y}_{\cdot \cdot j} - \bar{Y})^2$

variance due to interaction $T\Sigma_i\Sigma_j(Y_{\cdot ij} - \bar{Y}_{\cdot i \cdot} - \bar{Y}_{\cdot \cdot j} - \bar{Y}_{t \cdot \cdot})^2$

and unexplained variance $\Sigma_t\Sigma_i\Sigma_j(Y_{tij} - \bar{Y}_{\cdot jk})^2$

The loss of information due to the independence assumption is therefore equal to the interaction term. Implicitly, it is assumed that the mean square of the interaction has an insignificant F-test with respect to the error term, and thus that the error in ignoring its effect is small. For a concise discussion of the relationship of this technique to econometrics see, A.S. Goldberger, *Econometric Theory* (New York: Wiley, 1964), pages 227-231.

data, as classified in the tax analyzer, includes 80 possible cells. There are four age classifications: less than 25 years of age, 26-39, 40-64, and 65 and over; two sex classifications; and ten occupation groups: employees, farmers and fishermen, doctors and dentists and lawyers, other self-employed professionals, commissioned salesmen, business proprietors, investors, owners of rental property, pensioners and others. This operational constraint is a consequence of the means by which the tax analyzer incorporates the age, sex and occupation information into each tax record. Records are grouped across certain of the classification sets, i.e., professionals between the ages of 26 and 39 might not be differentiated by sex. In this manner the 80 possible classifications are represented in one 26 by 1 vector. This results in an inability to identify certain groups of taxfilers and thus information about their numbers is lost. Generally, those classifications which are aggregated are near-empty when compared with the size of the other elements in the sample, this being the reason for their aggregation, and the resultant loss of accuracy is small. The original operation,

$$X^t = Y^t * X^{to}, \text{ requires that } Y^t = (Y_{ijk})$$

be collapsed to a 26 by 1 vector to make it compatible with the dimensions of the X^{to} vector. It is the elements of this new vector which will be used to extrapolate the number of taxfilers for each of the three projection years. The X^{to} matrix is collapsed by a simple marginal summing of the appropriate rows and columns. The Y vector is formed under the constraint that the elements of the X matrix produced equal the sum of the original elements representing those characteristics over which the aggregation has been made. For example: let the *p*th cell represent the *i*th age component, and the *j*th occupation component, but not distinguish the taxfilers according to sex.

$$X_{ij\cdot} = \sum_k X_{ijk}$$

only $X_{ij\cdot}$ is known, its component parts being lost in the aggregation.

To maintain unbiasedness $f_i \cdot f_j \cdot S \cdot X_{ij\cdot} = \sum_k f_i \cdot f_j \cdot f_k \cdot X_{ijk}$

if, and only if $S = \Sigma_k f_k \cdot X_{ijk}/X_{ij\cdot}$

But X_{ijk} is unknown. Therefore a proxy must be found for S. S is simply a weighted average of the projection as a ratio over the original cell value. To maintain unbiasedness, over the entire population, the general inflator

$$G = \frac{NTR_t}{NTR_o} = \frac{\sum_i \sum_j \sum_k f_i f_j f_k X_{ijk}}{NTR_o}$$

which is also a weighted average of the multiples, should be employed.

The resultant Y vector, multiplied by the appropriate normalization factor, is used in the tax analyzer with slight modifications because of a breakdown, in one instance, of the independence assumption, and, in a second instance because of a change over the period in the treatment of pensioners which caused an overestimation of the slope of the trend in the over 65 age group.

The overestimation of the rate of change in the over 65 and pensioners groups was caused by an extension of eligibility for old age security to people between the ages of 65 and 70. To correct, a dummy variable analysis was carried out which estimated the effect of the new policy as a change in position, rather than shape, of the curve. This corrected a large overestimation in the estimation of the over 65 group in 1980.

The independence assumption broke down for pensioners over 65 both male and female. Unlike the other classifications, where the proportion of taxfilers with any one characteristic within a cell was relatively small, when compared to the numbers with that characteristic in the entire population, these two groups are closely identified. That is, most pensioners are also over 65. Therefore the extrapolation results in an overestimation if both f_1 and f_2 are used in these two cells. In order to correct the error the age multiple was replaced by G, eliminating double counting, but preserving the proper order of magnitude. In this manner, reasonably unbiased estimates of the numbers and distribution of taxfilers were made.

B.3 Demographic Profile of the Projected Taxfiling Population

Following the above procedure, the potential taxfiling populations of 1975 and 1980 are estimated on the basis of the potential labour force projected for these years. The estimated taxfiling population has been further broken down into an age, occupation and sex distribution according to the combinations of occupation classes, age classes and sex which are assigned to each taxfiler in the aggregation of the national taxation statistics and in the tax analyzer. The combination of the ten occupation groups and the four age groups (all described above) and the two sex groups into twenty-six age, occupation and sex classifications is detailed in Table B-1. In subsequent tables each of the 26 age, occupation and sex classes are identified by the Class number listed in Table B-1.

The occupation classification is based upon the major source of income earned by the taxfiler rather than on the type of work performed. This method of classification establishes a systematic identification of taxfilers. The age grouping has redistributed individuals in order to ensure comparability between the Ontario sample data and Canadian data. The method of redistribution is described in detail in an earlier study in this series of publications.[4]

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[4] *Analysis of the Federal Tax Reform Proposals, op. cit.*

Table B-1

Classification of Taxfilers by Age, Primary Occupation and Sex

Class	Age	Primary Occupation	Sex
1	21 or less	–	Male
2		–	Female
3	22-25	–	Male
4		–	Female
5	26-39	Employees	Male
6		Employees	Female
7		Farmers and Fishermen	Male/Female
8		Professionals, Self-employed Professionals, Salesmen, Business proprietors	Male/Female
9		Investors, Owners of rental property, Pensioners, Others	Male
10		Investors, Owners of rental property, Pensioners, Others	Female
11	40-64	Employees	Male
12		Employees	Female
13		Farmers and Fishermen	Male/Female
14		Doctors, Dentists, and Lawyers	Male/Female
15		Other self-employed professionals	Male/Female
16		Commissioned salesmen	Male/Female
17		Business proprietors	Male/Female
18		Investors, Owners of rental property, Pensioners, Others	Male
19		Investors, Owners of rental property, Pensioners, Others	Female
20	65 and over	Employees	Male/Female
21		Farmers and Fishermen	Male/Female
22		Professionals, Self-employed Professionals, Commissioned salesmen, Business proprietors	Male/Female
23		Investors, Owners of rental property	Male
24		Investors, Owners of rental property	Female
25		Pensioners, Others	Male
26		Pensioners, Others	Female

Inasmuch as each taxfiler is identified by his major income source it is to be expected that the relative growth of various classes of taxfilers will have a substantial effect on income growth. Since the present and proposed systems of taxation differentiate between various income streams, projected tax revenues will depend on the growth and distribution of taxfilers and, concomitantly, upon the relative growth of the various streams of national income.

Table B-2

Distribution of the Taxfiling Population by Age, Occupation and Sex 1967, 1975 and 1980

Class	Actual 1967 (thousands)	% of Total	Projected 1975 (thousands)	% of Total	Projected 1980 (thousands)	% of Total
1	662	8.1	1,015	8.7	1,247	8.9
2	489	6.0	893	7.6	1,200	8.6
3	463	5.7	710	6.1	873	6.2
4	319	3.9	581	5.0	781	5.6
5	1,537	18.9	1,786	15.3	1,897	13.5
6	683	8.4	943	8.1	1,096	7.8
7	71	.9	71	.6	72	.5
8	131	1.6	140	1.2	140	1.0
9	13	.2	24	.2	33	.2
10	27	.3	61	.5	91	.6
11	1,734	21.3	2,215	19.0	2,476	17.7
12	784	9.6	1,191	10.2	1,457	10.4
13	183	2.3	200	1.7	215	1.5
14	15	.2	19	.2	21	.1
15	16	.2	20	.2	22	.2
16	12	.2	19	.2	23	.2
17	203	2.5	230	2.0	239	1.7
18	75	.9	156	1.3	224	1.6
19	100	1.2	249	2.1	391	2.8
20	167	2.1	265	2.3	317	2.3
21	42	.5	54	.5	61	.4
22	35	.4	48	.4	52	.4
23	67	.8	119	1.0	161	1.1
24	76	.9	162	1.4	240	1.7
25	154	1.9	319	2.7	418	3.0
26	76	.9	186	1.6	267	2.0
Total	8,134	100.0	11,676	100.0	14,014	100.0

Source: The distribution of the 1967 tax filing population is based upon computer analysis of income tax returns. The projected distributions are derived from trend analysis of the separate age, occupation and sex classifications. The procedure is described above in Appendix B, Section B-2.

Note: Numbers may not add to totals due to rounding.

The estimated distributions of taxfilers in 1975 and 1980 detailed in Table B-2 have several important characteristics. The trends in age and occupation groupings indicate quite rapid relative growth in taxfilers under twenty-five, and in taxfilers over sixty-five, particularly those who are investors, owners of rental property and pensioners.

The under twenty-five age group of taxfilers is projected to grow from 23.7 per cent of the total taxfiling population to 27.4 per cent in 1975 and to 29.3 per cent in 1980. Investors, owners of rental property and pensioners, in the over sixty-five age group, will grow to 6.7 per cent and 7.8 per cent of the total population in 1975 and 1980, respectively, from 4.5 per cent of the total population in 1967. As might be expected from the trend to earlier retirement, the proportion of taxfilers over sixty-five who earn their greatest income from employment, professional and proprietor occupations will fall from 32.7 per cent of taxfilers over sixty-five in 1967, to 27.1 per cent in 1975 and 24.3 per cent in 1980.

Moreover, the trend growth rates indicate that the proportion of all taxfilers having their major income source in employment, professional, self-employment and proprietor occupations will fall from 69.1 per cent of all taxfilers in 1967 to 61.9 per cent in 1975 and to 57.7 per cent in 1980. Employment and professional occupations would be growing at an even slower relative rate were it not for the offsetting, fairly substantial increase in female employees.

The growth of female participation in the labour force is a significant element in the trend patterns of several occupation and age classifications. This can be seen most clearly in Table B-3. In each of the three occupation groups and the three age groups outlined in this table the number of females is growing more quickly than that of males. The only exception is in the class of employers over sixty-five, in which males and females are likely to increase at the same rate. These estimates of the future growth in the number of female employees filing tax returns are based on the increased rate of employment of women in the last decade, particularly in part-time positions.

Though female investors, relative to male investors, are not growing as rapidly as female employees relative to male employees, their growth does reflect the very rapid growth of all investors, owners of rental property and pensioners, relative to the growth of all employment, professional and proprietor taxfilers. In fact, the most dramatic increases are likely to occur in the number of taxfilers over twenty-five, who earn their largest income from non-employment occupations, that is, as investors, owners of rental property and pensioners. They account for 7.1 per cent of all taxfilers in 1967 and are projected to grow to 10.8 per cent and to 15.3 per cent of all taxfilers in 1975 and 1980, respectively. It is difficult to project the proportion of the under twenty-five age group who will earn their primary income from non-employment sources, including student fellowships and grants. It seems likely, however, that the proportion of students in this age group will grow. This likelihood is substantiated by the trend, in recent years, of the number of taxfilers under twenty-five to increase more quickly than the employed labour force under twenty-five. This trend is a reflection of the increase in the proportion of individuals under twenty-five who do not earn employment income but who are receiving other sources of taxable income and therefore remit tax returns. This trend has been projected to continue to 1980, at a somewhat lower rate than that observed from 1963 to 1968.

Table B-3

Growth Rates of Taxfilers by Age, Occupation and Sex

(percentage growth from 1967)

1975

Occupation

Age	Employees		Investors, Owners of Rental Property		Pensioners	
Sex:	M	F	M	F	M	F
26-39	16.2	38.2	89.9	125.9		
40-64	27.7	51.8	108.7	148.1		
65 and Over	58.8	58.8	78.4	112.2	107.1	146.3

1980

Occupation

Age	Employees		Investors, Owners of Rental Property		Pensioners	
Sex:	M	F	M	F	M	F
26-39	23.5	61.0	159.7	337.8		
40-64	42.8	86.0	200.3	290.6		
65 and Over	89.8	89.8	141.1	213.6	171.8	253.5

The overall trend across each occupation and age class is that individuals having their major income source in non-employment occupations will increase more quickly than those having permanent employment income and will form a greater proportion of the total taxfiling population in 1975 and 1980 than they did in 1967.

Females as employees, investors, owners of rental property and pensioners in each age group will be increasing more rapidly than males. Though the tax analyzer age, occupation and sex distribution does not distinguish between male and female professionals, self-employed individuals, salesmen and business proprietors, the trend indicated by the taxation statistics is that females in these occupation groups are not increasing more rapidly than their male counterparts.

Finally, the trends in age groupings indicate that taxfilers under twenty-five and over sixty-five will be increasing more rapidly than taxfilers twenty-six to sixty-four years old.

Table B-4

The Distribution of the Separate Occupation, Age and Sex Classifications

Occupation	1967 (thousands)	Projected Growth Rates 1975/1967 (per cent)	1980/1967 (per cent)
(1) Employees	6,796	38.9	62.1
(2) Farmers and Fishermen	307	12.9	23.6
(3) Professionals, Self-employed professionals, Commissioned salesmen Business Proprietors	423	20.0	28.3
(4) Investors, Owners of Rental Property, Pensioners, Others	608	127.0	241.9
TOTAL	8,134	43.5	72.3
Age			
(1) Under 25	1,933	65.5	112.2
(2) 26-39	2,462	22.9	35.2
(3) 40-64	3,122	37.7	62.3
(4) 65 and Over	617	86.8	145.7
TOTAL	8,134	43.5	72.3
Sex			
(1) Male	5,491	35.2	57.0
(2) Female	2,643	60.9	104.1
TOTAL	8,134	43.5	72.3

Source: The distribution of taxfilers by occupation and by sex in 1967 is compiled from the *Taxation Statistics, 1967* (Ottawa: Queen's Printer, 1969), Table 3 and Table 4.

Notes: The data for the age distribution of taxfilers in 1967 is derived from the tax analysis data. It differs from the *Taxation Statistics,* for 1967, in the age classifications and in the total number of taxfilers identified by age. In the *Taxation Statistics,* 16,164 taxfilers are omitted from the age distribution due to the lack of information on age on their tax returns. The tax analyser has distributed these omitted people through the age, occupation and sex classification according to the age distribution of taxfilers within each occupation and sex class, which is compiled from the *Taxation Statistics*. The assumption is that those who do not state their age are distributed through the population in the same way as those who do state their age. Though this assumption may not be valid, the error arising from a misspecification of the age distribution of 16,164 taxfilers, within a population of 8,133,695 taxfilers, is minimal. The projected growth rates are based on trend analysis of the age, occupation and sex categories. This analysis is described in detail above.

Table B-5

Growth in the Number of Taxfilers

Age, Occupation and Sex Classification	Percentage Growth from 1967 1975	1980
1	53.41	88.48
2	82.41	145.15
3	53.41	88.48
4	82.41	145.15
5	16.22	23.47
6	38.19	60.59
7	-.30	1.77
8	6.13	6.07
9	89.94	159.74
10	125.85	237.83
11	27.70	42.76
12	51.83	85.68
13	9.62	17.66
14	25.85	38.56
15	25.85	38.56
16	57.17	84.73
17	13.48	17.78
18	108.70	200.31
19	148.15	290.60
20	58.82	89.75
21	29.12	44.00
22	37.35	50.09
23	78.43	141.14
24	112.16	213.65
25	107.11	171.81
26	146.26	253.53
All Taxfilers	43.55	72.30

Source: Trend analysis of age, occupation and sex groupings.

The projected growth rates of the separate age, occupation and sex classifications are outlined in Table B-4. The joint growth rates of the age, occupation and sex distribution (Table B-5) can be derived from Table B-2. These projections of the twenty-six classes of age, occupation and sex groupings form the estimated population of taxfilers in 1975 and in 1980.

B.4 The Extrapolation of the Sources of Income

This section describes the breakdown of the G.N.P. projection, which is described in Appendix A, into its various components. These components of national income are used to inflate the corresponding sources of income of the taxfiler. The change in total income for each taxfiler then becomes a weighted average of the multiples, the weight being determined by the initial proportions of the components. In this manner the distribution of a person's income among the possible streams is allowed to change according to the national trends, but is constrained to be consistent with the original pattern of income sources.

The regressions used were based on revised data for the period 1947 to 1968 from the *National Income and Expenditure Accounts* of the D.B.S.. Each dependent variable, the component of G.N.P. to be estimated, was regressed upon Gross National Product in current dollars, minus net income of farm operators, using the same trend analysis functional form which was employed in the extrapolation of the number of tax returns.

Farm income, which is less regular than the other sectors, due to the volatility of some of its major contributory factors, was estimated separately. Farm income follows a periodic cycle, unlike the monotonic trends which are observed elsewhere. The exponential form could not adjust to this, hence an autoregressive structure was employed. Farm income was estimated as a function of the income of the previous four years, a functional form which captures the basic trend in the economy and allows a periodic cycle. Certain years had anomalous levels which could not be explained by the variables available in the model. To correct for these anomalies, which were not part of any consistent trends, a dummy variable was used in adjusting the basic data. The resultant function produced a difference equation of the form:

$$INC_t = \alpha_1 + \alpha_2 INC_{t-1} + \alpha_3 INC_{t-2} + \alpha_4 INC_{t-3} + \alpha_5 INC_{t-4}$$

which converges to

$$\alpha_1 [\ 1 - (\alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)\ ]^{-1}$$

which equals 1.31 billion dollars in this case. INC is farm income.

The resultant equations were then employed to predict the shifting shares of G.N.P. for 1975 and 1980. Normalization was used to impose the constraint that the sum of the sectors would add to the level of G.N.P. predicted in the National Product projected in Appendix A. Since the equation is of the form:

$$W = \beta_1 \, GNP^{\beta_2}$$

W, as a function of GNP, is: $W/GNP = \beta_1 GNP^{\beta_2 - 1}$

Thus, W is an increasing/constant/decreasing fraction of G.N.P. as β_2 is greater than one/one/less than one.

B.5 Growth Rates of Income Components

The trend equations discussed above and the projected G.N.P. yield the following estimates of the growth of income components.

Growth of Income Components

(percentage growth from 1967)	1975	1980
	%	%
Wage, salaries and supplementary labour income	88.4	177.3
Accrued net income of farm operators from farm production	0.7	0.5
Net income of non-farm unincorporated business, including rents	44.6	81.5
Interest, and miscellaneous investment income	175.5	389.8
Corporation profits before taxes	71.4	135.8

These aggregate growth rates are applied to the various income components of each tax return. G.N.P. is projected to increase by 93.2 per cent to 1975 and by 184.5 per cent to 1980. The long-run G.N.P. elasticity of the income components is close to one for only one growth path, that of wages, salaries and supplementary income. These remain a fairly constant percentage of G.N.P., from 53.9 per cent in 1968 to 53.7 per cent in 1980. However, the estimated trends indicate a substantial shift among the other components of G.N.P.. The secular decline in the relative proportion of farm income, from 7.3 per cent of G.N.P. in 1950 to 2.1 per cent in 1968, is projected to continue to 1980, when it is estimated that farm income will form 0.7 per cent of G.N.P.. Similarly, non-farm unincorporated business income has declined from 9.5 per cent of G.N.P. in 1950 to 5.9 per cent in

1968 and trend analysis indicates that it will form 3.8 per cent of G.N.P. in 1980. The long-term decline in the relative proportion of profits, from 14.0 per cent in 1950 to 10.4 per cent in 1968 is projected to continue to 8.6 per cent in 1980. In contrast to these trends is that of interest and investment income. It grew from 2.1 per cent of G.N.P. in 1950 to 3.6 per cent in 1968 and it is projected to grow to 6.1 per cent of G.N.P. in 1980.

These growth patterns of the various income streams determine the shift in the composition of national income over time and, in turn, determine growth of tax revenues.

APPENDIX C

SENSITIVITY OF REVENUE ESTIMATES FOR 1975 TO ALTERNATIVE DISTRIBUTIONS OF TAX RETURNS

TABLES

C-1 Percentage Difference Between Test Taxfiler Populations and Best Estimates for 1975 106

C-2 Personal Income Tax Effects of Federal White Paper Proposals on Tax Revenues from all Canadian Residents by Reform, 1975 107

C-3 Sensitivity Test of Shares of Total Income Tax Receipts Remitted by Income Class 109

SENSITIVITY OF REVENUE ESTIMATES FOR 1975 TO ALTERNATIVE DISTRIBUTIONS OF TAX RETURNS

The revenue and incidence effects of the present tax system and either of the proposed systems are particularly sensitive to the number and distribution of taxfilers in the target years. In addition to the best estimate of the taxfiling population used in the analysis, the implications of two additional distributions of taxfilers have been examined for 1975. The procedure used to derive the best estimate of the distribution among age, primary occupation and sex categories is described in Appendix B. The two alternative test distributions were derived using a much more arbitrary procedure. While the two test taxfiler populations differ only in certain classes, the differences in these classes reflect the two extremes in the possible range of values. The assumptions used to derive the two test populations are discussed below.

The percentage difference between the multiples used in the tests and in the best estimate to transform the 1967 taxfiling population to reflect the number of taxfilers in 1975 is shown in Table C-1. The classes in this table are identified in Table B-1. For example, the multiple used in the test to increase taxfilers in class one, males 21 years old or less, to the level expected in 1975 is 18 per cent less than that used in the best estimate.

In each of the two tests the number of employed taxfilers more than 26 years old is about the same as in the best estimate. However, the distribution of taxfilers among occupations classified within the civilian labour force differs greatly among the three sets of assumptions. Taxfilers less than 25 years old and other taxfilers whose primary source of income does not identify them as members of the civilian labour force are assumed to increase between 1967 and 1975 at a rate equal to the rate of increase in the total population within the appropriate age group over the interval. This is the minimum possible rate of increase in the number of taxfilers in these classes. In the past, and as the best estimate reflects, the proportion of individuals in these categories who file returns has been growing markedly in the last few years. The desire to estimate the minimum total number of taxfilers in 1975 leads to a total taxfiling population in each of the two tests which is about 12 per cent lower than in the best estimate.

These results are the consequence of various offsetting tendencies. In the tests, the number of taxfilers not in the employed labour force does not increase as rapidly as in the best estimate. Numbers of taxfilers in the employed labour force between the ages of 26 and 39 increase in aggregate by slightly more than in the "best estimate" and the relative shifts of the components are somewhat different. Farming and fishing returns decrease by even more than in the best estimate. This is offset by a larger increase in the number of taxfiling male and female employees as well as a substantially larger increase in the number of self-employed taxfilers. In test "B", the increase in the number of employees between 39 and 64 years of age is disproportionately low to test for the effects of a disproportionately

high increase in the number of self-employed taxfilers. In test "C", employees increase by about the same number as in the best estimate but numbers of tax returns from the self-employed, apart from those who are business proprietors, increase by somewhat less. In both tests "B" and "C", the number of tax returns for members of the labour force over 65 years of age increases less rapidly than in the best estimate.

With the "B" set of assumptions, revenue in 1975 from the present personal income tax and the federal proposals would be 6.0 per cent and 6.5 per cent higher respectively than under the best estimate. With test assumptions "C" revenue would be 3.6 per cent higher for the present personal income tax and 4.5 per cent higher under the federal white paper proposals.

The test results indicate the range within which the revenue estimates may be expected to vary given significant shifts around the best estimate distribution of returns within the taxfiling population.

A comparison of the implications of the assumed distribution of the taxfiling population under test "B" with the best estimate for the revenue effects of the federal proposals is shown in Table C-2. The results illustrate the lack of systematic relationship among the aggregate effects of the federal reforms. Like the analysis using the best estimate of the distribution of taxfilers, test "B" was done using the full sample of 196,000 tax returns for Ontario. Test "C" on the other hand, was performed on a much smaller sample. In the aggregate the small sample is accurate within 1.0 per cent of the figure from the full sample. However, judged by the effects of individual reforms, the small sample's accuracy is inadequate and the revenue effects by individual reform from test "C" have not been shown.

A summary showing the differences in the distribution of taxfilers between the best estimate and test "B" is shown in Table C-3. This table also shows the shifts in the relative shares of personal income tax receipts from various income classes yielded by the two distributions of taxfilers.

The rules used to create the alternative distributions of tax returns in 1975 were chosen to be as simple as possible. There is no suggestion that the resulting distributions reflect estimates of the most likely actual result. Rather they aim to test the effects on the revenue estimates of fairly wide deviations from the best estimate.

Tax returns filed by individuals not in the employed labour force are taken to increase at the lowest conceivable rate between 1967 and 1975. Thus, in classes one through four, the number of tax returns increases by the rate of growth of the male and female source populations between 14 and 24 years old. Tax returns of those receiving property or pension income whether between the ages of 26 and 39, 40 and 64 and over 64 increase at

the rate of growth of the source population for the relevant age groups. This is the rule used for class numbers 9 and 10, 18 and 19, and 23 through 26. Farming and fishing tax returns, classes 7, 13 and 21 are derived from independent estimates of numbers expected in these occupations and assumptions about the propensity of file tax returns. Numbers of fishermen are taken to remain the same in 1975 and 1980 as they were in 1967. In 1967 about 47 per cent of farmers and fishermen filed tax returns. In the tests, it is assumed that the propensity to file tax returns increases to 63 per cent by 1975.

In the tests, the taxfiling population in the labour force between the ages of 26 and 39 is taken to increase slightly more rapidly than in the best estimate. Class 5, male employees, is increased by the same rate at which the male civilian labour force increases between 1967 and 1975, adjusted for the relationship in the base year between the relevant labour force and the corresponding tax returns. The corresponding rule is used for class 6, female employees, and class 8 is estimated as the residual multiple to ensure equality of the labour force and total number of tax returns.

Tests "B" and "C" differ in their assumptions about the increase in tax returns among the employed labour force over the age of 39. Test "B" minimizes the increase among male and female employees and maximizes that among self-employed. Tax returns of employed men between the ages of 39 and 64, class 11, are increased by the general rate of growth of male taxfilers in the age group over the interval. Similarly, tax returns of employed women, (class 12), are increased by the general rate of growth of employed women in the age group. Other self-employed (classes 11, 12, 14, 15, 16 and 17) are then increased by the implied rate of increase necessary to ensure equality with the employed labour force total of the age group. This yields a very high rate of increase for these classes, up to 166 per cent greater than the number of tax returns in the best estimate in class 17 for 1975. In test "C", the returns in classes 14 to 17 are increased by the general growth rate of the civilian labour force over the interval for the appropriate age groups. In test "C", tax returns of the employed labour force over 64 are increased by the rate of growth of the civilian labour force in the age groups. In test "B", tax returns in this group are increased by a slightly smaller rate. In each case, this is a slower rate of increase than that indicated in the best estimate.

Table C-1

Percentage Difference Between Test Taxfiler Populations and Best Estimates for 1975

Class	Test B	Test C
1	-18.47	-18.47
2	-32.10	-32.10
3	-18.47	-18.47
4	-32.10	-32.10
5	8.26	8.26
6	3.10	3.10
7	- 8.59	- 8.59
8	29.69	29.69
9	-33.20	-33.20
10	- 2.93	- 2.93
11	-18.54	- 0.32
12	-14.40	-10.59
13	-16.80	-16.80
14	139.75	- 4.97
15	139.75	- 4.97
16	91.98	-23.91
17	165.89	5.39
18	-46.18	-46.18
19	-40.12	-40.12
20	-35.50	-34.35
21	-29.37	-29.37
22	-25.42	-24.09
23	-35.38	-35.38
24	-42.17	-42.17
25	-44.33	-44.33
26	-50.18	-50.18

Source: Computer sensitivity tests of tax return sample for effects of different tax filing population distributions on revenue estimates.

Table C-2

Personal Income Tax
Effects of Federal White Paper Proposals on Tax Revenues
From all Canadian Residents by Reform, 1975
($ million)

Changes in Tax Rates, Exemptions and the Treatment of Employment Income	Best Estimate	Test "B"
Changes in tax rates and exemptions	541	618
Changed definition of medical expenses	95	88
Attribution to employees of employer medicare contributions made on their behalf	153	156
Inclusion of scholarship and fellowship income in the tax base	12	11
Optional standard expense allowance	-107	-167
Attribution of top employee benefits	190	216
Working mother allowance	-21	-21
Deductibility from income of unemployment insurance contributions	-54	-56
Inclusion of unemployment insurance benefits in income	145	163
Changes in the Taxation of Other Business and Property Income		
Disallowance of losses on rental property arising from capital cost allowance and other specified expenses	34	34
Taxation of capital gains and allowance of capital losses of unincorporated businesses	11	8
Taxation of non-business capital gains and allowance of non-business capital losses	63	69
Farm capital gains and other farm income added to the tax base	7	8
Changes in the Taxation of Corporate Source Income		
Effects of integration of corporation and personal income taxes and allowance for half integration on widely-held common shares	-33	+15

Table C-2 (cont'd)

Personal Income Tax
Effects of Federal White Paper Proposals on Tax Revenues
From all Canadian Residents by Reform, 1975

Changes in the Taxation of Corporate Source Income	Best Estimate	Test "B"
Taxation of capital gains and allowance for capital losses on corporate stock and reduction of capital gains rate on shares of widely-held corporations	444	465
Widening the corporation tax base	–123	–112
Disallowance of shareholder depletion deduction	12	14
Inclusion of unreported dividends	7	6
Allowing unrealized capital gains on private companies to remain untaxed at death	–102	–104

Source: Computer analysis of tax return sample.

Table C-3

Sensitivity Test of Shares of Total Income Tax Receipts Remitted by Income Class

1975

Income Class	Per Cent of Taxfilers in Class		Per Cent of Total Tax Revenue			
			Best Estimate		Test B	
	Best Estimate	Test B	Present System	Federal Proposals	Present System	Federal Proposals
Less than $ 5,000	48.62	42.69	9.21	8.30	7.60	6.77
$ 5,000 – $ 7,000	18.68	18.35	14.34	13.49	12.47	11.71
8,000 – 9,999	10.07	11.48	12.15	11.98	11.94	11.81
10,000 – 14,999	12.56	15.16	21.55	21.93	22.21	22.58
15,000 – 24,999	7.13	8.74	20.34	20.78	21.43	21.78
25,000 and Over	2.94	3.58	22.41	23.52	24.35	23.35

Source: Computer analysis of tax return sample.

Note: Numbers may not add to 100 per cent due to rounding.

APPENDIX D

GOVERNMENT EXPENDITURE PROJECTION

TABLES

D-1 Estimated Government Expenditure 114

D-2 Proportion of Government Expenditure to be Borne by Income Taxes 115

GOVERNMENT EXPENDITURE PROJECTION

In the derivation of current dollar Gross National Product used in the analysis, real government product is assumed to grow at 7.1 per cent per year between 1967 and 1980. This is the rate indicated by the Economic Council of Canada in 1969 in its Sixth Annual Review.[1] The Economic Council developed this rate following a review of expenditure by all levels of government. The rate is that which would be expected to accompany rapid economic growth with government policies as they existed in 1967. This assumption is consistent with the level of sustained full-employment economic growth employed in the projection of real Gross National Product to 1980.

In analyzing the current dollar value of government expenditure it is assumed that inflation in this sector does not exceed the average for the economy of 2.5 per cent per year. It has been argued that the structural shift in the economy away from the private and towards the public sector has been among the sources of inflation in the economy in the recent past, in part, a result of the intense competition for skilled personnel between the public and private sectors.[2] This study does not take account of the possibility of inflation in the government sector being higher than the average level of inflation in the balance of the economy, largely because it is assumed the sectoral shift will diminish in the future. Thus, in the projection of potential output to 1980, government employment is not assumed to increase its share of about 11.0 per cent of the civilian labour force to 1980.

With the assumption of 7.1 per cent real growth and 2.5 per cent inflation in the government sector, estimated government current and capital expenditure in Canada is expected to grow from $13.9 billion in 1967 to $16.8 billion in 1969 and $46.8 billion in 1980. This represents an increase from 21 per cent of G.N.P. in 1969 to 25 per cent of G.N.P. by 1980. The figures are presented in Table D-1.

Revenue from the present income tax structure financed about 61 per cent of government expenditures in Canada in 1969. In the same year, under the federal white paper proposals revenue from income taxes would have financed about 69 per cent of government expenditure. Under the present system this grows to 63 per cent by 1980; under the federal proposals this grows to 72 per cent by 1980. Under the Ontario proposals, the proportion of government expenditures financed by income tax revenues increases from 60 per cent in 1969 to 66 per cent by 1980. The gradual increase in the share of government expenditures which all three systems could finance is shown in Table D-2. If expenditure does increase at the rate indicated in this analysis there will be funds available from the income tax structure to reduce the burden of the more regressive property and sales taxes. The analysis indicates this is true of the present system, to a somewhat greater extent true of the Ontario proposals and, to an even greater extent, true of the federal proposals.

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[1] Economic Council of Canada, *Sixth Annual Review, op. cit.*, page 32.

[2] Hon. C. S. MacNaughton, "The Structure of Public Finance in Ontario", *Ontario Budget 1970, op. cit.*, pages 47-48.

Table D-1

Estimated Government Expenditure

($ million)

	1967	1969	1975	1980
Government Product				
Constant (1961) G.D.P. basis	3,285	3,768	5,687	8,013
G.D.P. basis, current dollars, 2.5 per cent per year inflation	3,896	4,695	8,218	13,105
G.D.P. basis, current dollars, 5.5 per cent per year inflation	3,896	4,973	10,350	19,061
Government Current and Capital Expenditure				
Current dollars, inflation at 2.5 per cent per year	13,923	16,778	29,367	46,832
Current dollars, inflation at 5.5 per cent per year	13,923	17,753	36,987	68,116
Government Expenditure as a Percentage of Estimated G.N.P.				
Current dollar, inflation at 2.5 per cent per year	21	21	23	25

Sources: Government product in constant (1961) dollars is from the G.N.P. projection of potential output at full employment to 1980 described in Appendix A. Government product is assumed to grow at 7.1 per cent per year in real terms.

Constant (1961) dollar government current and capital expenditure for 1961 and current dollar government current and capital expenditure for 1967 is from, *National Income and Expenditure Accounts, 1926–1968.* Actual current dollar government current and capital expenditure for 1969 is $16,767 million, as compared with the estimate of $16,778 million, is from, *National Income and Expenditure Accounts,* Second Quarter 1970, D.B.S. cat. no. 13-001.

Notes: Government current and capital expenditure is government current expenditure on goods and services and government gross fixed capital formation in residential construction, non-residential construction and machinery and equipment. Government expenditure is on the *National Accounts* basis. Government product is placed on a government expenditure basis by multiplying estimated government product by the ratio of constant (1961) government expenditure from the *National Accounts* to that of estimated constant dollar government product for that year. The result is then normalized by the factor which equates the estimate to current dollar government expenditure for 1967 from the *National Accounts.*

Table D-2

Proportion of Government Expenditure to be Borne by Income Taxes

(per cent)

	1967	1969	1975	1980
Present Tax System	61	60	61	63
Ontario Tax Proposals	–	60	63	66
Federal White Paper Proposals	–	69	70	72

Source: Total income tax revenues are from Table 1-2. Total government expenditure data is from Table D-1. Total income tax revenues for 1967 are from Table 6, Government Revenue, *National Income and Expenditure Accounts, op. cit.*, Second Quarter 1970, page 21. Total income taxes include federal, and provincial direct taxes of persons (excluding Canada and Quebec pension plans) and direct taxes of corporate and government business enterprises, the sum of rows 2, 3 and 7.

Notes: Figures for 1969 through 1980 are estimates based on the procedures outlined in this study. Figures for 1967 are actual data. Government expenditure grows at 7.1 per cent per year in real terms and experiences 2.5 per cent per year inflation.

Ontario